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Particles and Fields-Magnetosphere

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5770 Short-period veriations of magnetic field RARMONIC STRUCTURE OF PG 3 - 5 MAGNETIC PRISATIONS OSSENYER AT THE STOWN-WESAPELL CONJUGATE PAIS TOWN-WESAPELL CON

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Planetology

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Department of Geological Sciences, University of Texas at Austin, Austin, TX

What is the lithosphere? What things subduct, what things do not, and why? How is the lower continental crust larmed? Where are the large-ion lithophile elements stored? Is the style of place terronics episodic? These and related questions were considered during a workshop held at the University of Texas at Austin in March 1982 under the spunsorshin of the U.S. Geodynamics Committee (USGC) The objectives of the workshop were somewhat musual in that participants were asked to identify assumptions underlying proposed models and hypotheses, with special emphasis on controversies inherent in the various models. No attempt was made to reach consensus. The flavor of the discussions is indicated by die questions above, devised by a steering committee, each serving as the point of departine for approximately one half day of the wide-ranging discussion.

The rationale for the workshop is summarized in the first paragraph of the report (The Lithosphore, Report of a Workshop, National Academy Press, Washington, D. C., 1983): The plate tectonics model has been remarkably successful in rationalizing the kinematics of surficial materials of the earth's interior. A key element of the plate rectorics model is that the onter rigid shell of the earth is made up of discrete plates capable of independent motion with respect to each other. By conrention, this assemblage of plates constitutes the earth's lithosphere. According to existing models, the lithospheric plates are formed at ocean ridges and elescend into the earth's interior at subduction zones. Knowledge of the lithological and perrological characteristics of this lithosphere is thus a major element in understanding the dynamic processes of the outer layers of the carth."

At the workshop, Don Anderson noted the differing criteria that have been applied in identifying the lithosphere. Originally defixed as the outer stony shell of the earth, it was fater defined to include the following: elastic or flexural lithosphere, calculated from surface adjustments of loading and unloading, usually between 20 and 30 km thick; thermal lithosphere, the cool outer layer of the earth which supports a conductive thernal gradient and is computed to be about 100 km thick; and seismic lithosphere, overlying the witlespread, though not necessarily arld-wide, scismic low velocity zone (LVZ). The depth of this zone may be less than 15 km beneath young occaus and, if identifiable, is about 150 km beneath the continental shields; the LVZ is generally, but perhaps erroneously, equated to the authenosphere. A chemical-mineralogical lithosphere may be postulated if the nuter portion of the mantle

is layered or grossly heterogeneous. The assemblage of rigid independently translating plates constituting the plate tectonics model may not be identical with any of the above concepts of the lithosphere. In general, rigidity is the controlling factor. However, for continental plates it has been suggested, on the basis of seismic travel time in the upper manile, that the lower humilary may beneath low density mantle material honded to the crust and is hence much deeper

than that of the thermal lithosphere. An upper mechanically strong layer and an underlying weak zone are essential components of the plate tectimic model. There is, lowever, no general agreement on the physical nature of their mutual boundary or the parameters that must be measured to define it. The physical characteristics of the lower thosphere also remain unclear. Observations of fundamental-mode surface waves and magnetotelluries do tiot allow the vertical resolution necessary to reveal detail in this dynamically important region. The most promising approach may be die study of full seismic wave forms using synthetic seismograms and array methods to map the threedimensional variations of this boundary.

# Crust and Upper Mantle

The two major seismic discontinuities that divide the earth into crust, mantle, and core have been known for many decades, but their precise character is still uncertain, The Moho beneath oceanic crust is commonly related to an ophiolite model, the velocity difference being due either to a cumulate ultramatic zone beneath gabbro or to a contrast between upper serpentiuized and underlying less serpenlinized ultramatic mantle rocks. The drilling of deep holes in oceanic crust is perhaps the only way to resolve this uncertainty. The nature of the Moho beneath continents is even more conjectural. Seismic refraction data uspally reveal a distinct Moho. However, deep crustal reflection profiling seems to show a discentinuous, layered zone approximately at Meho depth, Proposed interpretations of this zone include layered metasediments, cumulate layering, tectonic banding, sill-like intrusions, and lenses of partial melt. The Gutenherg discontinuity between mantle and core is characterized by a zone of scatter in seismic velocities. If convection in the core is main-

ognized at depths near 650, 400, and 220 km. The low velocity zone for shear waves lies above the 220 km discontinuity. The cause of the low velocity is much debated. Crystal orientation by mantle flowage, partial melting of mantle material, and chemical dilferences are suggested causes. The 400-km, and especially the 650-km, discontinuities are strungly reflective and apparently can be mapped over large areas. The discontinuity at 4001 km is commonly regarded as a phase transition, either ulivine to spinel structure or wroxene + garnet to a garnet solid solution It has recently been suggested that the 220 and 650 km discontinuities represent boundaries between chemically distinct regions in the mantle. The 650 km discontinuity is close to the maximum depth of observed earthquakes; a thermal boundary layer related to mantle convection has been postulated for this discontinuity, but not for those at 220 and 400 km.

Observed lateral variations with age of thernminechanical, seismic, and electrical properties of the oceanic lithosphere can be dusely approximated by thermal models. However, lateral heterogeneities within the continental crust, beneath the continentorean boundaries, or deep within the mantle remain poorly understood. For the oceancontinent boundary, one school of thought suggests that significant deep thermal hetero geneity is prevented by the development of instability in a thermal houndary layer; another suggests that continents have deep roots, the expression of a chemical laundary layer. Consequences of these two models are quite different for plate tectonics and global geochemical balances. New long-period digial seismic networks, higher mode surfacewave regional studies, and perhaps electrical conductivity surveys are promising methods for mapping large-scale lithospheric structural and fithologic variations.

High electrical conductivity anomalies in the deep crost beneath the continents are evidence for lateral inhomogeneity of shield areas. Interpretation of the anomalies in terms of either partial melt or high water coment is controversial. The high conductivity seems to suggest that the lower confinental crust is in a

The most notable global event related to continents in the last 250 m.y. was the formation and subsequent breakup of the super confinent Panger. Was this an accident, or domajor episodes of rilting always begin within very large confinental masses? If the latter is the preferable hypothesis, does this mean that the mesent scathor voreading in the Pacilic had its origin in the breakup of an earlier giant continent? This may be a realistic scenario. Paleomagnetic measurements show that the earth had a magnetic field at least 3.4 b.y. ago and that apparent polar wander at rates comparable to those of the past 150 m.y. has occurred through geologic time. There were intervals of the earth's history

when the major continental masses remained fixed for long periods, and there were episodes when magnetic reversals were rare nr absent. There were also periods when apparent ar true polar wander was particularly rapid. The apparent correlations between the above observations lend some credence to the speculation of a cause-and-effect correlation between core processes and mantle convection. A possible explanation is that changes in the spin axis of the earth are not followed immediately by corresponding changes in the direction of the spin axis of the inner core. Such differences could result in a reversal in direction of the main magentic field. Reversals, therefore, may arise as a result of changes in the direction of the earth's spin axis caused by muvements of the plates at the surface, which also affect the convective and thermal regimes of the mantle.

#### Dynamics of Tectonic Plates, The Geoid, Hot Spots, and Convection

The general pattern of plate movemen over the last 150 m.y. is reasonably well known, and there is wide agreement that the basic driving mechanism is some form of convection in which the lithosphere itself may be an active component. However, important questions remain: How are rifting and spreading initiated? What determines the pattern of seafloor spreading? Are the processes leading to rifting and basin formation the same? Is convection in the mande layered or whole mantle? Are phase changes and partial melting more important than thermal expansion? What are the roles of continental Insula-

tion and subductive cooling? Suggested events leading to initiation of rifting Include thermal pulses, plate collisions, sedimentary loading, crustal stretching, phase changes, and effects of continental insulation and membrane stresses induced by true polar wander. Questions abound: Is continental rifting driven by thermal processes from below, perhaps dominated by hot-spot activity? Why do oceanic tidges commonly assume a configuration of perpendicularly spreading

Fig. 1. Analysis of seismic velocities indicating possibility that a cold high-Q slab extends into the lower mantle. (Source: Redrawn Irom T. H. Jordan, Mosaic, 12, 1981. Reprinted with permission.)

ridge segments and a transform fault system that approximates the irregular shape of an initial break? Why do some rifts continue to develop into ocean basins while others fail to do so? Does rifting follow periods of rapid

true polar wander The process by which subduction is initiated is also poorly understood. A large ampli-tude disturbance is needed because both continental and oreanic lithosphere are stabilized against small amplitude vertical dellections. Flexural strength permits damping of perturbations and isosiasy prevents buckling. No generally accepted models exist for the initiation of subduction. The rate and mechanisms of assimilation of subdurted lithosphere are also unknown. In the plate recomics model, the downgoing slab is a thiver of plate motions, a probe for mantle theology, a carrier of chemical communicants, and a cooling agent for the last mantle. Combuctive thermal models for the hearing of subducted slabs indicate that the approximately 10 million-year residence time between the surface and 670 km is inadequate to allow thermal re-equilibration of the stab. At this depth, therefore, the slab should still have a density in excess of that of the surrounding mantle. Travel time residuals have, in fact, been interpreted

1000 km, well into the lower mantle (Figure D, though the evidence has been questioned. One of the most exciting opportunities for decades to come is that of directly mapping patterns of flow within the upper mantle by measuring seismic amsorropy. The theoretical framework necessary for describing propagation of seismic waves in a spherical anisotropic carth has been developed recently. Such measurements could, for example, supply independent evidence of the validity of the iniportant concept that hot-spot traces provide a reference frame for motions of the litho-

av indicating presence of states to depthy of

sphere plates relative to underlying mande. Hot spots are the virface manifestation of a widespread planeiary process that we do not yet understand. Are they related to cracks in the plates, or do they represent a fundamental component of mantle convection? Hot spots apparently persist for tens of millions of years and move only very slowly with respect to each other. They thus provide a useful frame of releience. Motions with respect to the hot spots are the chief observations constraining models of place-thriving

mechanisms, as discussed below. Hot-spot magmas and contained xenoliths provide much of what we know about the mantle's perrology and geochemistry, but questions still abound. For example, do the different geochemical signatures seen among active hot-spot volcanocs persist through time, or do individual hot spots have as much variation over their lifetime as that observed among currently active hot spots? Do ancient hot-spot intrusions have the same geochemical characteristics as modern ones? Could these similarities or differences be used to discriminate among models of mantle evolution? To what depths do the roots of hot spots extend (Figure 2)? What causes hot spnis? Are they related to a mantle convection system? Does the starting up or fading out of hot spots trigger episodes of true pular

Recent studies of the geoid demonstrate a strong correlation between hot spots and long wave length good highs, although the hot spots themselves cannot be the sole source of excess mass to produce these highs. Both also correlate with regions of extensive continental Cretaceous volcanism. Gondwana may have lain approximately over the Atlantic-African geoid high during the Permian; this possibility has led to the suggestion that routinental Insulation is a prime factor in the loca-

tion and generation of hot spots (Figure 3). While the geoid highs are centered over the equator, the Atlantic-African region and the central Pacific, geoid lows are concentrated in a polar band, which at present also contains much of the continents and ancient shields. Continents may have migrated to these lows (presumably related to colder mande) and away from hotter mantle, perhaps a product of continental insulation and the absence of subduction-related cooling processes In a previous cycle. Africa is situated on a geold lilgh but is fragmenting. If the geoid highs firm under continents in polar regions, they will rotate the continents to the equator,

the changes in distributions of mass thus causing true nolar wander.

As a result of recent advances in satellite geodesy and altimetry, we now have reasonably good global information on the gooid. Density heterogeneities at a variety of scales are required to generate the stresses that deform rocks and drive mantle convention and lithospheric creation and destruction. This data see may be the best observational constraint we now have on the geometry of con-

vection in the maptie. Many uncertainties remain concerning the physical and chemical characteristics of the earth's interior. They can be resolved only through experimental audies on materials likely to be present there. Information from these investigations will assist us in interpreting seismic discontinuities as phase or chemi-cal boundaries and determining constraints on the temperature distribution in the upper mantle. Recent advances in seismic theory also make it possible to estimate temperature. as well as stress. From the damping of seismic waves. The same theory provides the connection between seignic anclasticity and viscosity. All of these new uses of seismic data require lahoratory calibration.

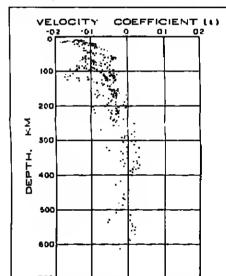


Fig. 2. Velocity structure under the Yellowstone caldera. The normal velocity multiplied by the velocity coefficient (h) shown along the abcissa gives the velocity anomaly. Each point in the scatter diagram is based on one residual came. Note that no seismic "root" is evident below 300 km. Does the Yellowstone hot spot have its origin near this depth? (Source: Reprinted from H. M. lyer et al., Geol. Soc. *Am. Bull.*, 92, 792–798, 1981. Reprinted

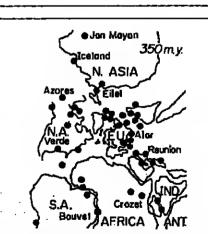


Fig. 3. The location of the continents about 850 m.y. agu. Also shown are hot spots, most of which are currently in the Athintic and Indian occurs and under the continent of Africa. The continents moved slowly north during the next 150 m.y, and then broke up and dispersed to their present locations. The majority of present-day had spots were beneath Gondwanaland for a long period of time prior to 200 m.y. ago and may have formed as a result of continental insulation. (Source: Reprinted from D. L. Anderson, Episodes, 3, 507, 1980. Reprinted with permission.)

Article (cont. on p. 321)

WaterWater Neur of the historing recting

Editor: Mary C. Amlerson, Department of Geologi and Geophrais, Purversit of Wromain Madison, Mahyan, WI 817m

## News & Announcements

# **Coaxing Clouds** Over Jerusalem

It is faining 15% more in certain parts of Brack these winter days, and the man responsible for it is Avraham Gagin of the Meteorological Department of Jerusalem's Hebrew University.

Gagin beads the research that has made Isract the world leader in artificially influed precipitation, where the piguilations intently consumes more than 95G of the available was

Using the conventional methods of sloud seeding, the injection of a line posider of silver indide itan a cloud. Gagin undestly says, the "powers" of his stall lie in knowing which clouds to seed. "We don't make rain." he says, "we simply encourage the min-producing cloud to let down more precipitation than it inclinately would have." Israelichatter the clouds with silver indide from above and below. Crop dusting planes are used, spraying the chemical into the clouds from generators under the wings. From the ground, silver todide is sent up through vasi balleries of generators located throughout the country.

Although in 1982-1983 Israel experienced one of the wettest winters in recorded history of this area. Israel's water reserves are not only low, but have reached what some exneris cult a "crisis level." Israel's ivo main wa ter sources are the Sea of Califee in the north, led by the fordan River, and natural underground reservoirs from which water is

### HORTON RESEARCH GRANT PROPOSAL

The American Geophysical Union is soliciting proposals for the Harton Research Grant. One grent, in the amount of \$5,500, is awarded annually in support of raseerch projects in hydrology and water resources by a Ph.D. cendidate in an American institu-

The objective of the grant is to loator gredualo sjudent research lending to the completion of decloral dissertations. Processis may be in hydrology, including physical, chomical or biological especte, or in the walor resources policy sciences, including economics, systems analysis, sociology

The deadline for proposels for the 1984 grant is April 30. For a delailed description of the greni end e guide lar proposers.

write of cell:

Horton Research Grent Member Programs Department American Geophysical Union 2000 Florida Avenua, N.W. Weshington, DC 20009 202/4B2-B903

pumper to the surface through attestan wells. In spite of the heavy tainfall, the Sea of Galilee is still at its lowest level in 20 years and aquifers are in danger of drying out, consequently suffering damages that can interfere with a smooth water flow. Some critics object to the rainmaking project saying it ampers with nature. Gagin, who sees their point of view, says that "in get back to natural minfall, we would have in go back thousands of years," before such phenomena as defoliation from overgrazing and the felling of trees

influenced the annual rainfall.

The induced rainfall seems to be reversing the depressing situation of water supplies in Israel and, for that matter, in countries that border brael. When rain-making activities were started, the attempts were a well-kept secret, for no one knew how the rload seeding would affect the weather of the neighboring Arah states. But when the University of Chicago published data from studies in Arab countries next to Israel, a 20% increase in rainfall was showing up in Jordan, Lebanon, and Syria. Authorities here assume that the Arabs were "not displeased," Israel's vainmaking techniques are benefiting contairies outside of the Middle East, Recently, a delegation of leading meteorologists and water conservationists from South Africa came in terusalem to learn from the experts here. In addition, Israeli metemologists have been disnatched be Pern where an Israeli company Agridey, has been employed to develop a vast arid area of that Latin American contury.

This from were inhanitted by Ellen Havidson, Offor of the Consulate General of Israel, New York.

# On The Waterfront

The following members of the Hydrology Section have been selected to receive Presidential Young Investigator Awards ( Em. March 13, 1984, p. 97).

Roman Krzysztofowicz, Univ. of Virginia; Daniel R. Lynch, Partmonth College; and Jery . Stedinger, Cornell Univ.

Oric L. Loucks has been appointed the new director of the Holomph Research Institute. ndianapolis. He has established three areas ul research for the Institute; water aciences. piotic resource analysis, and environmental communics and policy analysis. The water sci-ences program initially is being developed around the existing Ground Water Mudeling Center currently based at the Hologub Research Institute

# Opinion

### Mesoscale Meteorology/ Hydrology Experiment?

Scientilic progress in the field of surface water hydrology appears currently to be constrained by a tack of comprehensive field data involving the coordinated simultaneous observation of many meteorological and hydrologic variables at mesorcale. Mesoscale merenrological experiments are under active discussion by (11 a U.S. interagency (cam and (2)) the World Climate Research Program. The tydrologie research community should enure that its interests are represented in the

planning for these unique experiments.
Historically, the field of surface water bydralugy has grown out of an engineering need to provide adequate water supplies over the long-term and to provide flood protection in the short term. Early work involved the collection and analysis of station records of precipitation and streamflow, and their use in developing lumped (i.e., one-dimensional) models of the precipitation-randif behavior

af watersheds As the field has natored, and as the observational and analytical tords have developed, we wish and need to ask more suphisticated

 Our growing interest in the heliaving of larger physical systems and in climatic regines having predominately convective storms demands that we deal explicitly with the spatially distributed character of both the

atmospheric forcing and the land surface. 2. Our concern with the large-scale environnental inspacts of proposed tropical mac-ro-engineering projects such as deforestation in the Amazon Basin and dramage of the White Nile swamps requires that we consider the interactive behavior of the land surface/

atmusphere system. 3. Improvement in short-term hydrologic lorecasting, be it for flood warning or for other operational purposes, such as the control ed irrigation releases, musi involve inclusion of some of the physical/dynamical aspects of precipitation fornlation

Advance in these areas requires both clever

modeling and comprehensive data sets, and the latter do not exist. It is the opinion of many hydrologists that our science is currently constrained by the absence of such data.

Our Precipitation Committee has undertaken a multi-disciplinary effort to define and stimulate the analytical and experimental precipitation research needed by hydrologists. This Committee is chaired by Vijay K. Corpta of the University of Mississippi, and its membership contains physicists, atmospheric scientists, mathematicians, and statisticians in addition to hydrologists. They have organized a session at the Spring 1984 AGU meeting on Investigations on Mesoscale Precipitation Fields, which is jointly sponsored by the Hydrology and Armospheric Sciences Sections. and have prepared an article on precipitation research which should appear shortly in Eoc. We hope that this statement of our inter-

ests and needs will help bring about a similar interdisciplinary ellert on the experimental Peter S. Eagleson

AGU Hydrology Section

#### Hydrologist Certification: Two Views

I recently received a letter regarding the registration of hydrologists but paid little attention. Now with Peter S. Eagleson's, president of the Hydrology Section, comments in Eus (Jan. 11, 1984, pp. 9-10) I realize there must be quite a controversy. I would like to comment, particularly with regard to the atgument that registration will protect the pub-

I am a registered professional forester in California. Therefore I am qualified to practice there. Carrect? Legally, yes. Professionally, in most regards, no. I have never done the type of forestry work for which the registration law was primarily designed. My experience has been primarily with louslifields and rangelands or with tree species of the sub-

> With 25 years in forest hydrology research and water resource planning. I could almost surely quality for registration as a profession al hydrologist. My studies include undergradwate and graduate courses in hydrology at the University of California, Berkeley, and Colorado State University. I consider myself a forest hydrologia, but to modify that to prol'essional hydrodogisi would be to claim a general level of competence I likely do not have.

Finally, initials are no real protection to the public. I have just finished reading a report by a consulting engineering turn. The report is authored by five PE's and two CPAg's. The report is mostly about trees. It is also investy incorrect. It is error ridden and full of unsupported, inconsistent, and unknowledgeable statements. The authors were unprofessional in this case since they this not make sure that someone among them understand how trees grow. As a result the larger of that report was ill served in spite of all the initials behind the authors' names. I am afraid that rofessional "professionals" will always be with us in spite of everything.

Hydrology is inverdisciplinary by definition, cannot imagine a hydrologist worthy of the name who does not have a core profession such as meteorology, engineering, agricul-ture, or even forestry. Requiring a named profession as a prefix, as in forest hydroligist, would be far more meaningful to the public than the term "professionals." Let's leave it at that rather than trying to decide who is, and who is not "professional."

Robert A. Merriam

I applaud the decision of the Hydrology Section Executive Committee in remaining neutral in the debate concerning government certification of hydrology professionals. The two reasons cited in Water Watch in East Jandary 10, 1984, pp. 9-10) are indeed the ones usually put forth by those in favor of state certification. There is, however, a third reason that is seldon; stated but nevertheless rery much a factor in the minds of many of those behind the certification movement: the regulation of competition, particularly the entrance of new practidoners into the marketplace. By controlling the numbers of practinoners through licensing requirements, state accredited professionals—particularly those accredited professionals—particularly those who are "grandfathered" in when the law is passed—can limit competition and command a larger share of the available market for

professional services. We are now seeing a trend toward reduced government regulation of many industries. It will be unfortunate if hydrologists overlook the reasons for and benefits of this trend and instead pursue greater regulation of their own profession. Certification of professional excellence can be readily accomplished within the framework of professional societies such

as the American Society of Civil Engineers without resorting to begal mechanisms to control who can and cannot practice.

> Cars H Holzhausen, Applied Geomechanics, Inc.

# Meetings

# **Hydrology Days**

The AGD From Branch is sponsoring three Hythology Days to be held April 24-26, in the Student Center at Colorado State University in Fort Collins, Colo. Student papers will be presented on the first day, and professional papers will be presented on the second and third days, John Breileloeft, U.S. Geological Survey, will be the leatured speak er at a function; on the first day of the program. The title of his talk will be "Water Management: Who are the Managers?" For more information contact H. J. Morel-Seymux, Colorado State Phiversity, Civil Engineering Department, Fort Collins, CO 80523 Helephone: 303-491-85494.

#### Penrose Conference

A Geological Society of America Penrose Conference on Transport Processes in Frac-tured Rock, will be held from September 24 to 28, 1984, in Park City, Utah. The objective of the emference is to bring together recent advances in our understanding of the physics of mass and heat transfer in fractited porous uedia, in simulation methodologies bir mass and heat transfer, and in the experimental determination of system parameters. The conterence leaders are Leslie Smith and Frank Schwartz, Participation is restricted to alout 80 people. For more information conraci Leslie Smith, Department of Geological Sciences, University of British Colmulia. 6839 Stores Road, Vancouver, BC, Canada

#### Gordon Research Conference

A Gordon Research Conference on Make ug of Flow in Permemble Media will be beld n Andover, N.H., July 30 to August 3, 1984 The purpose of the meeting is to discus catrent issues in the modeling of fluid line plenoniena in permemble media. Invited speak ers include J. Bett, J. R. Philip. P. A. Witherquon, R. W. Gillham, H. C. Helgeson, T.A. lewett, H. C. Hatilyer, K. O'Neill, F. M. Richter, J. Noorishad, J. Wheeler, T. Poenira, I. Dull, R. Ewing, P. Sammon, J. Bell, . Wallis, A. Weiser, L. W. Gelliar, W. A. lury, and S. P. Neuman. The chairman of the meeting is T. N. Narasimbha, Earth Sci ences Divisium, Lawrence Berkeley Laboratory, Berkeley, Calif. Participation is limited to about 100 participants. Applications may be obtained from A. Cruickshank, Gordon Research Conferences, Pasture Chemical Lab oratory, University of Rhode Island, Ringston, RI 02881.

# Sink Hole Conference

The first multidisciplinary conference of sink links will be held October 15-17, 1984. in Orlando, Fla. Geologists, engineers, geographers, and others from related disciplines are invited to attend and present pal conference is being sponsored by the Florida Sinkhole Research Institute, University of Central Florida, College of Extended Studies, Orlando, FL 32816-0177.

# Irrigation and Drainage Congress

The 12th International Congress on Irriga tion and Drainage will be held in Fort Collins, Colo., from May 28 through June 1985 The American Water Resources Association (AWRA) is true of more than 20 cooperating organizations sponsnring the conference. There will be a special session on the impact of the energy crisis on irrigation and drain age and a symposium on new developments. In the protection of irrigation, drainage, and flood control structures on rivers. For more Information contact Larry Stephens, Executive Segments tive Secretary, U.S. Committee on Irrigations Drainage and Flood Control, P.O. Box 1532b, Denver, GO 80215 (telephone: 803-234-3006).

#### National Water Well Conference

The National Water Well Association (NWWA) is sponsoring a conference on the Practical Applications of Ground Water Models to be held in Colmobus, Chio, on August 15-17, 1984. The NWWA is also sponsoring the 7th National Ground Water Quality Symposium, September 26-28, 1984, in Las Vegas, Nev. The theme of the conference is eveloping and Implementing Immentive Means of Dealing with Potential Sources of Ground Water Contamination." Abstracts are due May 25, 1984.

For more information on both conferences contact David M. Nielsen, NWWA, 50tt West Wilson Bridge Road, Worthington, OH 43085 (telephone: 014-840-9355).

### ACS Groundwater Sessions

The American Chemical Society (ACS) wil hold a series of teaessions on groundwater in a 3-day period cluring a national meeting of the ACS to be held April 28 to May 3, 1985. in Miani, Fla. All papers will be invited. For more information contact Willa Garner, U.S. Environmental Protection Agency, Washington, D.C. (velephone: 703-557-0320).

### **AGU Fall Meeting:** Statistical and Hydrological Criteria in the Safety of Dams

The AGU Surface Rupoff Committee is organizing a special session on dam safety at

the Fall 1984 meeting in San Francisco. During the last few years, research has been directed toward the analysis of risks and uncenainties, risk-based design and analysis of statistical, georeclinical, and hydrologic issues in the safety of dams. This sersion shall focus primarily on risk and hydrological lactors associated with the design and ralety of dants. Papers are solicited ilealing with risk-

for speediest treatment of contributions send

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age of waves in the coastal zone at the

uorthern tip of the Goto Islands, Japan.
The Goto Islands lie south of the island of

Taushima and west of the Japanese island

of Kyushu. The raw SAR image data were collected by the Japan Self Defense Air Force by using a Goodyear AN/UPD-4 sys-

ten on an F-4 Phantom Jet. This scene

was collected on November 29, 1981, at a

speed of 270 m/s from an altitude of 3847

m. The radar depression angle was about

correlated on the precision optical correla

Division to create strip imagery on 70 mm

45°. The raw phase history was optically

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512 x 512 pixel scene. Digital exploitation

lucluded geonjetric correction to the ground plane, local spectra creation, and

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three copies of the double-spaced monuscript to one of the editors named below and one cripy to

The Weekly Newspaper of Geophysics

based design, quantification of risks, nucer-tainties and probabilities of lailure, suchastic aspects of reservoir operation related to blood control and dam salety, dam break problems, and hazard identification. General papers dealing with the mechanics of flow in danibreak situations may be accepted for presentation. The focus of the session will, however, be on risk and reliability aspects of dam safety, livited papers deal with the use of random field models, probabilistic tisk analysis, determination of the composite risk of failme, risk-based design, reservoir operation and dam safety, and relationships of failure probabilities to earthquakes and Ilond insur-

Please mail three copies of your abstract to AGU and one to U. Lall, Department of Civil Engineering, 3012 MEB, University of Utali, Salt Lake City, UT 84112 (801-581-6701), the session organizer.

Deadline for special session: August 15,

# **Remote Sensing** and Remote Data

The American Society for Testing and Materials (ASTM) is sponsoring a Symposium on Georeelinical Applications of Remote Sensing and Reniole Data Transmission in mid January 1986 at New Orleans, Organized by ASTM Committee D18 on Soil and Ruck, the I-day symposium will be one part of the 4-

day spring meeting of that committee. The purpose of the symposium will be to develop information that can be used in prepare guidelines for the use of new remote sensing tecliniques for a variety of projects involving georeclinical engineering and to the use of satellite transmission for on-site instrumentation data. The program will be designed to show advantages and disadvantages of various remote sensing and remote transmission techniques, equipment, and programs related to soil mechanics, rock mechanics, geologic engineering, groundwater hydrology, and other scientific input to geoechnical engineering studies.

Offered and invited papers will be scheduled for oral or poster presentation. All papers will be reviewed and considered for pulslication in an ASTM Special Technical Publication. Presentations will be selected by a Program Committee on the basis of submittell abstracts. Prospectice authors are invited to submit a fide and a 200-500 word abstract

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to symposium chairman A. Ivan Johnson, insultant, Woodward-Clyde Consultants, Harlequin Plaza-North, 760tt East Orchard Road, Englewood, CO, 80111 tielephone: 303-425-5610 or 303-604-2770).

To receive information on the symposium or for detailed instructions for submittal of abstracis, contact symposium chairman A. Ivan Johnson or Kathy Greene, ASTM Publications Division, 1916 Race Street, Philadelphia, PA 19108 (relephone: 215-299-5414).

### Hydrology at **Spring Meeting**

The Hydrology Section will sponsor the following special sessions at the 1984 annual spring meeting in Cincinnati, (May 14-17): Groundwater Transport: Field Methods, Mon. PM; Transport Processes I and 11. Tues. AM and PM; Mesoscale Precipitation and II, Thes. AM and PM; Catchment Geochemistry, Wed. AM; Hillslope Hydrology,

Thurs. AM; Sediment Storage, Thurs. PM. The general session on groundwater will be held Monday and Wednesday mornings. The general hydrology session will be held Veilnesday afternoon.

# Workshop on Hydrologic Applications of Space Technology

The International Association of Hydrological Sciences (IAHS) and the World Meteorological Organization (WMO) are planning for an International Workshop on Hydrologic Applications of Space Technology: Input to Hydrologic Models and Geographic Information Systems, to be field in Florida in mid to late 1985. The city and exact plate will be announced later.

The workshop program will emphasize of-fered and invited oral or poster papers related to the input of remote sensing and remote data transmission to hydrologic models and geographic information systems. Field trips to NASA's John F. Kennedy Space Center and other points of scientific interest will be part of the program. An exhibit and demonstration of pertinent equipment, systems, and programs will be available, as will a display of related books and periodicals.

Organizations interested in exhibiting equipment, systems, or publications or in degraph after equipment of Software programs should contact A. Ivan Johnson, President, IAHS International Committee on Remote Sensing and Data Transmission, 747-1 Uphain Court, Arvada, CO 80003, Persons wishing to offer un oral or poster paper for consideration by the program committee should submit a typed single spaced origina and one copy of a 400-600 word abstract, in English, to Mr. Johnson at the above address or 10 J. Nemec, Director, Hydrology and Water Resources Department, World Meteorulogical Organization, Case Postale No. 5, CH-1211 Geneva 20, Switzerland.

# Meeting Reports

### **AGU Hydrology** Section

Report of Meeting Chairman

numerous accounts of some of the presenta-

Subscription price to members is included in an Subscription price to members is included in annual does (\$20 per year). Information on insolutional subscriptions is available on request. Second-class postage paid at Washington, D. C., and at additional mailing offices. Eat, Transactions, American Grophysical Union (1SSN 0096–3941) is published weekly by The Executive Committee of the AGU Hydrology Section met in regular session at 4:00 P.M. on Thursday, December 8, 1983, in Room 378 of the Cathedral Hill Hotel, San Francisco, Calif. Seven board members were present with section president, Peter Eagleson, presiding.

American Geophysical Union 2000 Florida Avenue, N.W.

A total of 18 sessions were presented in lineations superimposed upon the wave San Francisco, and all were well attended, as crains are aligned parallel to the surface was reported by progrom chairman Dennis Lettenmaier. Added to the regular sessions of wind of 9.8 m/s. Their periodic nature allow the surface wind direction to be accu-General Hydrology, General Ground-water Hydrology, and Sediment Transport were rately extracted from local spectra. These wind rows have been interpreted as resultthe following special sessions: Glacier Ocean ing from convective roll vortices. Existing Interaction, presider Edward Josberger; Orlempirical relations and auxiliary weather ooco and the Amazon, presider Edward Andata, in conjuction with wind direction drews; Transport and Geochemical Interacand wave period extracted from the local tions in Stream Water, presider F. E. Ben-SAR spectra, were used to estimate significola: Instream Flow Requirements for Fish, presider Brian W. Mar; Multivariute Modelcant wave height and aerodynamic roughness parameters at the sea surface. Some ing of Hydrolugic and Other Ceophysical Time Series, presiders Jose D. Salas and Da-vid R. Dawdy: Optimization Techniques for of diese estimated and extracted parameters are incorporated in this sea-state image, which combines original imagery, re-Managing Cround Water and Stream Aquigionally processed apectra, and text sym-bols. This image was analyzed by Gary A. Mastin, Oscar K. Huh, and S. A. Hsu of fer Systems, presider Steve Gordick; Treat-ment of Evapotronspiration Soil Moisture Evolution and Aquifer Recharge in Water-shed Models, presiders Arlen D. Feldman the Coastal Studies Institute, Boton Rouge, as a part of research sponsored by and Hubert J. Morel-Seytoux; Statistical Prothe Coastal Sciences Program, Office of cedures for Estimating of Flood Risk at Gauged Sites, presider J. R. Stedinger; and Searching for More Physically Based Extreme Value Distributions in Hydrology, presider Naval Research; Arlington, Va. Special thanks are given to Kenji Wakui of the Japan Self Defense Air Force for supplying the raw data. (Figure courtesy of Gary Mastin, Sandia Nudonal Laboratories, Albumianana. Juan B. Valdes, The session on Clacier Ocean Interaction received the most publicity, with buquerque, N.M.)

tions appearing in the newspaper. One of the pleasant surprises of the meetings was the high attendance at the special sessions on Opumization Techniques for Managing Ground Water and Scream Aquifer Systems and Multivariate Modeling of Hydrologic and Other Geophysical Time Series. Both sessions were highly interdisciplinary, attracting numerous scientists from other sections of AGU.

lu his absence, a memorandum from John R. Ritter, the program chairman for the AGU Spring Meeting in Cincinnati, was given en. Seven symposia or special sessions are planned for the Spring Meeting. Two sessions in Water Quality; one session in Sto-chastic Elements of Nonpoint Source Pollotion Mudels and Water Quality and Geochemistry of Small Catchments; one session in Erosion and Sedimentation on Sedimenta tion Storage in Rivers and Estituties; one session in Surface Runoff on Hillslope Hydrology; two sessions in Grannelwater, Miscible and Immiscible Transport in Grundwater and Field Methods for Supporting Groundwater Chemical Transport Mudels; and one session in Precipitation on New Research Directions in Modeling of Precipitation in Space and Time. It looks like a full schedule of ropics which should arreact excellent speakers

#### Reports of the Editors of Water Resources Research

Steve Burges repusted that a mild editorial board meeting was held this year. With the dust of the page charge issue baving settled, no major or resonnding controversy was caised. Steve Burges introduced Ronald G. Cummings, the new editor of the social science side of Water Resources Research, Cummings stated that his goals were to continue the purmotion of Water Removes Research as the journal for publishing high quality, policy sciences papers dealing with water-related pupils, and to increase the level of participation and involvement with the intrinal he scholars in sciences concerned with systems analysis and operations research as well as the social sciences; economics, political science, law, history, and geography. Cammongs has sent 1,500 leners to individuals in water research, department charpersons, and directors of state reater resource research institutes calling for quality, water-related papers dealing with policy issues. Commings has added hee new associate editors to his stall and has connected previous and existing associate edibus for combining and assistance in the expaining of Water Remains Research

In a memoraudium to Perer Lagleson, Mary Anderson, the cilitor of Water Watch, a new hydrology news column appearing in Eos. repour that the first edition has appeared in early January. She also requested that anyone with ideas for a logic for the column should send them to her: Mary Anderson, Departntent of Geology and Geophysics, 1215 W. Dayton Road, University of Wisconsin, Madison, WI 53706. Contributions of luture editions of the quarterly column are welcome.

#### Report of the Technical Committees

Eight of 10 technical committees submitted reports on their activities to present and their plans for the future. These reports will be sent to Mary Anderson to be abstracted and the abridged versions to be published in Water Watch. Those communees submitting the written reports were Erosion and Sedimentation, Water Quality, Precipitation, Surface Runoff, Policy Sciences, Soil Water, Snow and Ice, and History and Heritage.

#### Status of Soviet Hydrology

A written report was submitted by Nathan Burns to the Executive Committee on the status of the publication, Soviet Hydrology. Buras reports that, although Soviet Hydrology publishes translated papers from a broad range of sources. of sources, these papers seem to be specific technical applications of well-established principles. He points out that this does not diminish the value of these papers in professionals, but it is questionable whether or not they are

To be sure, high-quality papers are published in the Soviet scientific literature in the area of hydrology and water resources, but they are scattered in several periodicals. The important Russian publication is Water Resources which, it appears, is currently translated in toto into English. Another important source of original papers is the Doklady of the various sections of the Soriet Academy of Sciences. For example, important papers regarding the design and operation of sucface reservoirs may be found in the section on cybernetics. Buras suggests that a screening board be established within the Soviet Union to help in the process of choice. Such a screening board was discussed with our Soviet collengues in Hamburg, and its implementation is now being considered

#### AIH

Peter Engleson, section president, reiterated the Executive Committee's position in regard to the American Institute of Hydrology. AGU is a research body and, as such, should not be actively involved in the process of certifying hydrologists. He referred to a letter by Jay Lehr of the National Water Well Associa-(cont. on b. 324)

toot. June p. 3231 toon where state certification activities are being pronoted as opposed to national certification. It was a concusus of the Section Exemise Committee that all Inriber action or discussion about AIII come to an end.

#### **Business Meeting**

The business meeting of the AGP Hydrology Serion meeting but been session at 12:00 moon on Wednesday, December 7, 1983, at the Holiday Im: Golden Cateway. The meeting was presided over by Section President Peter Eaglyson.

#### Death of James Amoroelio

It was with great sathress that Peter Eagleson announced the antimely death of James Amerocho of complications due to previous open heart surgery. Amorocho, a long-time member of ACO and past recipient of the Florron Award, had been active in the field of hydrodogy until the time of his death. He served on monerous section committees as an associate editor of Water Resource Research (WRR) and, at the time of his death, was chairman of the Florron Scholaship Committee. He will be missed by all.

# New Editor of the Social Science Side of WRR

Ronald G. Commings, professor of ecomining at the University of New Mexico, was introduced as the new editor of the social scicuce sale of WRR. Commings promises to be an extremely active editor, continuing and expanding the past work of Jacol Cohon, homes editor.

#### Physical Science Editor of WRR

Styve Burges' term as editor of the Physical Science side of WRR expires in July 1984. Rafael L. Brias has been mained shairman of the nomination committee to fill the secanty. Suggestions for manimations should be sent to Rafael L. Brias, Ralph M. Parsons Laboratory, Repartment of Civil Engineering, Massachusens Distitute of Technology, Cambridge, MA 02139.

#### New Journal on Applied Hydrology

Some interest has been voiced among Hydrology Sertion invinhers for the formation of a new journal on applied hydrology. An informal polling of the membership has been suggested. An opinion, for or against, should be sem by letter to Peter Engleson, Room 48–335. Massachusetts institute of Technology, Cambridge, MA 02139.

#### Policy Sciences Committee

The old Water Resource Systems committee has been reorganized and renamed. It is now known as the Policy Sciences Committee. The new committee chairperson is Helen Ingram, Department of Political Science, University of Arizona. Helen is a renowned scicoust in the field of water policy and instintions.

#### Committee on History and Heritage

William Back has been tramed chairman of the History and Heritage Committee. This new committee will promote items, articles, and reports on the history of the hydrologic sciences. There are funds available for historical activity through the AGU Council.

Correspondence regarding the committee should be addressed to William Back, U.S. Geological Survey, National Center, MS 431, 12201 Sunrise Valley Drive, Renon, VA 22002

#### Program Cltasrntan

Peter Englesion gave high praise to Dennis Lestenmaier for his excellent organization of this year's fall meeting. Dennis will continue on as Program Chaitman for the Fall 1984 Meeting. All should be rentinuled that the Spring 1984 Meeting is to be in Cincinnati, Ohio, May 14–17.

#### Chapman Student Travel Fund

A general AGU fond, the Silnes Chapman Memorial Lecture Fund, is available for support for travel for a limited number of students to Chapman Conferences where no other travel funds are available. One student will be supported for a meeting of 60–90 attendees, two students may be funded for a meeting with over 100 attendees. The grants will rover er ononly an face only.

#### Reserve Fund

The AGIT Cannoil has decided to maintain a liquid assets frind of 50% of annuar expenses to allow AGIT to weather a severe contonic storm to to take adsantage of inforeseen new opportunities. To rearly this 50% goal, about 5% of expenses will be inadgeted from surplus each year. This amounts to approximately \$300,000 a year. The 50% goal translates into a reserve fund of \$1,360,000.

#### Horton Award

This year's recipient of the Horton Award was David A. Woulhiser. Woulhiser is a research scientist for the Agricultural Research Station, Theson, Arizona, and an adjunct professor of hydrology and water resources.

University of Arizona, Tucson, Arizona. He reveived the award for his longstanding work in watershed systems.

# Flood Estimation

The three sessions on flood entimation a the Fall AGU meeting were well attended and quite successful. A brief synopsis is provided here. On Wednesday, S. Yaknwitz and K. Adamowski both illustrated how nonparametric procedures could be employed to estimate pullability density functions. Such procedures du unt require dat one assumes that Hond flows come from a pre-specified parametric family. Other papers addressed how information other than just the at-site ganged record could be employed to estimate flood risk. J. Salas discussed the use of record angmemation procedures based on bivariate Gumbel distributions. T. Colm showed how "historival" records documenting the absence or occurrence of large floods could drainatically improve clesign flood estimates at gaged sites. Finally, C. Tasker proposed the use of generalized least squares (GLS) procedures for ileriting estimators of flood quantiles as a function of basin characteristics; the GLS rechnique accounts for the sampling error and cross correlation of the flow quantile estimators. The procedure provided more accurate parameter estimates, nuch better estimates of the accuracy of the model's parameters, and an almost unhiased estimate of the

During the formal morning session on Friday, sereral authors again considered the use of regional information in Hood risk estimation. D. Wall discussed a study examining use of both hinorical fluid records and of regional regression constituts which also demonstrated the value of historical flood information, I. Herrin presented an evaluation of the Water Resource Council's nilut test of a wide range of procedures for estimating design floods for angaged catchments. The "index flood" method and the U.S. Geological Survey's regression estimators were the most precise as well as being easy to apply. W. lumas reported on the Water Resource Council's development of Bulletins 15, 17, 17a, and 17b; the uniform approach current ly recommended is based on an evaluation of operational procedures available in 1974.

The use of regional information to improve flood estimates at ganged sites was addressed. C. Alarin discussed an empirical Bayesian methodulogy and Monte Carlo results documenting its potential advantages. D. Lettenmaier presented another study; while certain empirical Bayesian procedures sometimes did well, others often did poorly in

some respects. The afternoon session addressed the use of stysically" based procedures for estimating flood flow distributions. Many questioned what that term meant; V. Klemes indicated that such procedures employed models based on some reasonable theory relevant to the mena in question. R. Bras noted that when a theory is inadequate to predict the nomena's behavior, one must fall back on calibration and parameter estimation procedures. In such cases, the supposedly physically based models primarily serve to define a parametric probability distribution whose parameters must be entimated from available flood data just as the parameters of normal, lognormal, and Pearson distributions are of-

P. Todorovic advocated the use of partial urainn series procedures. By using more infurmation than just the largest peak observed each year, they could provide more accurate design flood estimates than annual flood series procedures. V. Gupta considered the characteristics of the arrival process of significant rainfall and flood events. Finally, R. Bras discussed his work with J. Valdes, M. Diaz, I. Rodriquez-Iturhe, and M. Gonzalez on instantaneuus unit hydrograph procedures which provide an estimate of the distribution of major floods using solely observable paameters describing physical characteristics of a basin plus the mean rainfall intensity and nican duratism of storms. Results were promising and shuw that the theory, in addition to its significant scientific value, may be nearly ready to aid in the determination of flood distributions at unganged sites.

The meeting closed with a panel discussion which reflected upon the papers presented and littire research needs and apportunities. The importance of scaly to hydrologic profelems was discussed. There seemed to be universal agreement that several lines of research were combing in fruition and promised both scientific advances and operationally useful procedures; furthermore, the treed to keep it mind these dual purposes for hydrologic research was emphasized. Some research is oriented more tuward adstrucing scicuce and some toward water management concerns. This dichnumy has led to confusion when research, whose aim is to contribnte to one of these objectives, is unjustly faulted for fading to contribute to the other. Attempts are being made to make a written summary of the pantel discussion available; these can be obtained by writing J. R. Ste-

This meeting report was contributed by Jery R. Stedlinger, U.S. Geological Survey, 410 National Center, Resion, VA 22092.

# Multivariate Modeling

The special session entitled Multivarians Modeling of Hydrologic and Other Geophysical Time Series was held during the AGT Fall Meeting in San Franciscoon Thursday. December 8, 1983, and was sponsored by the Surface Romoff Committee of the Hydrology Section of AGU. The session brought together about 100 participants from different this iplines, including hydrologists, occanographers, meteorologists, and statisticians, to discuss the state of the art and new developments of stochastic description and modeling of multiple time series of hydrolog-

ic and geophysical phenomena. The papers and discussion generated during the session covered a wirle variety of hydrologic rariables such as streamllow, precipitation, specific conductance, ground vater and water use, meteorologic variables such as air temperature, wind and pressure, and oceanographie variables such as ocean temperature and velocity. Among the ropics discussed were: modeling that is oriented to data generation of multivariate processes, ba sie data analysis and description of statistical characteristics in time and space; modeling specifically oriented to forecasting the processes involved; transfer of hydrologic and geophysical information; and detection of iges in hydrologic information.

Positions, questions, and confinents inade during the panel discussion, in addition to stirring the pot a little bit, served to put see eral issues in perspective. One issue addressed was model complexity. One of the panelists, who may be the grandfather or erhaps the Godfather of synthetic hydrology, and who, having been present at the creation of some of the concepts about which much was heard and discussed in this special session, questioned whether anything substanual has been done. Is it necessary to have models with so many parameters? Is the information contained in any model or metamodel redundant or useful? Perhaps models in their own metabolism have replaced processes, and we may be modeling models instead of real physical processes. In addition, the ease of computation may have lead us to worry too much about micro-procedures. This may be regretable, and a need for phi Insophy and new language may be in order. Some other panelists appeared to agree with the foregoing points, although more cau-

It has been about 20 years since the univar inte AR(1) model was first suggested for modeling hydrologic processes; it has been about 15 years since the multivariate AR(1) model was suggested for modeling multisite processes; it has also been about 15 years ince the ARMA models have become piquilar for modeling senes of natural phenomena; and it has been about 10 years since the disaggregation model was hirst introduced in hydrology. Hence, it is not too surprising that the majority of the papers presented in the session reflected the experience gained during the last 10 years and the efforts to overcome some of the shortcomings inherent in some of the "traditional ntodels and npproaches." For instance, there were lengthy discussions on the subject of models with parsimony in the number of parameters, buth for the direct multivarinte models as well as for the disaggregation models. It is now than that simple multivariate models retain the necessary flexibility of reproducing the basic properties shown by most annual time series of geophysical phenomena. Likewise, it is now clear that the major shortcoming of disaggregation models (i.e. the large unmber of ters) may be overcome by step disaggregation, a scheme with a minimum number ameiers that preserves the needed covariances and additional property. These procedures certainly have addressed the question of model romplexity, redundancy, and passimony which was put forward during the panel discussion.

Other points raised during the panel discussion include the following questions: Does anyone care about modeling and generation anyway? Is it really better to use synthetic samples than to use historical records alone? How would designers react to designs made from synthetic hydrology if these designs deviate significantly from those derived by conventional activities or those derived by simply looking at history? Could one not select a model which supported one's prior inclinations? Has synthetic hydrology produced design suggestions well outside the limits proposed by historical records and conventional teclulques? If so, have they been "explained nway" or simply ignored as being mere artifacts of the random number generators.

facts of the random number generator?

Certainly we wish we could have answers to the foregoing questions, but any one answer will not please everyone concerned and will be controversial. Synthetic hydrology has been useful for considering various long-term assessments associated with sequences of flows. Documented studies have been made on the subject not only in the United States and Canada but in other countries as well. However, these issues, although quite important, were not discussed in the special session. The main purpose of the session was to discuss the state of the art and new developments in modeling multiple time series of hy-

thrologic and other geophysical phenomena. Perhaps it is now time to think and plan another meeting in the Giture to discuss insigsperiheally the torogoing questions.

In summary, the special session served to identity some of the shortcomings of the traditional modeling reclumpors and the ways to circumpent them. It served to indicate how multivariate modeling of certain repeat bydrologic processes such as annual streamflow may be effectively done with modely that age simple, while modeling of periodic processes such as short-term precipitation as bell as short-reim increasological and occupyraphic events are more complex thre to the extreme cariability they often exhibit and due to the inherent irregular and gappy data bases which are available. The session also serred to put some other relevant issues under perquestive, such as those related to measuring the benefits of lorecasts and evaluating and documenting the real uselidness of mulicariare modeling cerliniques in the realm of practical decision making.

The exact titles and the abstracts of the papers may be found in *Eos*, Nov. 8, 1983. Interested readers should write to the authors for ropies of the papers. On behalf of the Surface Roundl Committee of the Hydrology Section of AGC, the session organizer wants or express his deep approximation to all session participants for making this, along with the flood sessions, one of the hyst suchastic hydrology meetings in a number of years.

This overlong report was written by Jose D. Szlas, Associate Professor of Gird Engineering, Colorado State University, Fort Collins, CO 80323.

#### Article (cont. from p. 321)

#### Geochemical Reservoirs

On the hasis of samples from many locations in the means, it is widely (but by no means universally) assumed that the oceanic lower crust resembles the base of obtained ophishite sequences. For rominental lower crust, however, we know only a lew possible examples, represented by high grade granslite terrains and by xenolith unies from volcanic pipes. Hence, the physical properties, compositional constraints, and scale of beterogeneity of the lower continental crust are poorly known.

Plate tectunits models suggest a long evalutionary history and probably great diversity. Do ismopic ages determined for the lover crust represent true ages of rock mais? Bo ages march the oldest overlying upper crustal rocks, or have they been successively reset during additive processes from the upper mantle or from lateral subdiction? The more malic compositions of the deep crust postulated from seismic velocity data are difficult to reconcile with the silivic-to-intermediate gueisses seen in possible exposures of deep crustal rocks.

Major questions related to the composition and evolution of the upper mantle can be approached through xenylith research, bar, in, there are more questions than answers: Are geotherms, derived from the equilibri assemblages of peridotites and eclogites, masient phetromena related to mantle dispiriso and kimberlite genesis? Are inflections in geotherms real? Are they related to thermal boundary layers? Are kimberlites produced lry diagree? Why are other magmas not produced with them? What are the scales of lateral and vertical herer ogeneitles implied by the varied xenulith strites in single pipes or lircalized groups of pipes? What are the mechanisms and kinetics of the widespre metasomatism of the uppermost mande that is erident in compusite or velned xenofiths and is required by several models of basalt genesis? Are ismopic ages of xenolidis appar ent or real? Is suboceanic mantle different in composition from subcontinental mande? What is the Mohornylcic discontinuity?

Fluxes of materials through subduction zones are crucial to the evolution of die line sphere-mantle system but are poorly underatood. It is widely believed that subduction zones are the loci of generadon of new continent crust, but every link relading subducted ithosphere to continental crust is still serious y debated. Important uncertainties include he source of island arc magmas, the sources f their trace elements, the average compo tion of island arcs, the nature and degree of reworking of mature island arcs, the average composition of continental crust, and die retionship of the latter to island are compo tion. Isotopic studies now suggest that ancient recycled oceanic crust and lithosphere may play an essential cole in the production of modern mid-ocean ridge basalt (MORB) as well as ocean island basalts. The possibility that modern basalts are windows to ancient recycled crusts bears upon numerous as of manue reservoirs and evolution and on the kinematics of the subduction process itself. Furthermore, the synchronous appearance a volcanic activity over wide areas, both intraplate and at margins, suggests magmatic pro-cesses that may linve only an indirect relation to the movement of plates.

The number, size, and spatial arrangements of major geochemical reservoirs capable of yielding distinctively different magnaters a subject of vigorous debate. Several very different models are advocated. One general

CC - confinental crust OC - ocean crust mid-ocaan ndge LIL- Isrge-Ion IIthophlies confinents flood basalts bssall sourc ocean isisnd basalis basalı OC ] traction peridollie primitive manile LIL residue eclogile dillerentistion events dapletad lower manifa

Fig. 4. A model for the evolution of the mantle. Primitive mantle (1) is partially molten either during accretion or by subsequent whole mantle convection which brings the entire mantle across the solidus at shallow depths. Ltl. elements are concentrated in the neb. The deep magma ocean (2) fractionates into a thin, plagioclase-rich surface layer and deeper, olivine-rich and garnet-rich cumulate layers; (3) late-stage melts in the eclogite cumulate are removed [4] to form the continental crust (c.c.), entich the peridoite layer, and deplete MORB's, the source region of oceanic crust (o.c.), and the lower oceanic lithosphere. Partial melting of the plume source (5) generates continental flood basalts (CFB), ocean island basalts (O1B) and other enriched magmas, leaving a light, depleted residue. (Source: Reprinted from D. L. Anderson, Science, 213, 82–89, 1981 with permission.)

gravilational

sirsillication

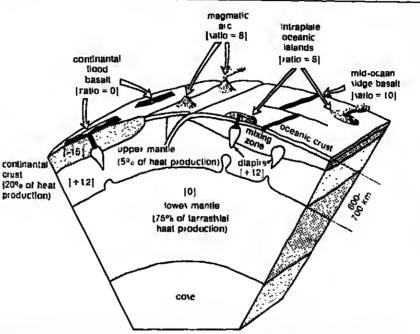


Fig. 5. Contrasting hypotheses for evolution of the catth's crust and mantle and for location of geochemical reservoirs. Figure 3 suggests a complex history of early earth differentiation leading to a depleted, inert lower mantle and a geochemically active upper mantle. A different model, from DePaulu, also emphasizes an active upper mantle, but shows plumes originating as dispirs from the lower mantle. (Source: Reprinted from D. J. DePaulo, Ear Trans. AGU, 102, 137–140, 1981.)

type postolates a primitive lower mantle, an enriched layer (at the top or the bottom of the mantle), and variously enriched or depleted heterogeneities scattered through the mantle. Another requires continuing chemical exchange between the mantle and core and between the upper and lower mantles. In still other models the main magma reservoirs are in the upper mantle; the lower mantle is the depleted crystalline residue from early earth differentiation (Figures 4 and 5).

Information on the nature and magnitude of fluxes between reservoirs is essential to an understanding of the chemical and differentiation history of the earth. The nature, thickness, and origin of subcontinental lithosphere and its relationship to the overlying crust are subjects of widely divergent hypotheses, ranging from the view that its base is a thermal boundary layer directly analogous to oceanic lithosphere to the view that it is chemically disjinct, thick, and a major reservoir of incompatible trace elements.

Oceanic island and ocean ridge basalts have recendy been interpreted as having geochemical signatures of recycled ancient oceanic crust, raising anew the question of whether the differentiation of the mantle has proceeded irreversibly or is approaching a steady state with recycling. Oceanic island volcanic rocks are distinctly more enriched in incompatible trace elements than are mid-ocean ridge basalts. A widely accepted model assumes that die global extent of these latter rocks implies a mande layer of global extent as a source, but the isotopic data, especially of helium, lead, and neodymium, indicate that this source must be heterogeneous. However, the measurement of rare gases, particularly He<sup>4</sup>He, shows that recycled oceanic crust is unlikely to have been a the major contributo to at least some oceanic island basalta.

The mande apparently contains substantial quantities of volatiles, some of which give evidence of being primordial (\*He, 129Xe). Components such as H2O and CO2 may be recycled from crustal materials. Once introduced

into the mantle, these volatiles will play a profound role in mantle magnatism, as shown by experiments with systems containing variable GOe/H2O ratios. Volatile transport in the mantle has been invoked as a mechanism to produce mantle metasomatism as a precursor to the production of basaluc liquids. In appears unlikely that the current tectonic

regime could have come into being on a totally pristine, undifferentiated earth. The formation of the earth by accretion was clearly a violent process, which probably involved extensive melting and stirring related to core separation, thermal convection, and ronvection driven by chemical bouvancy differences The end product could have been a layered or fromogeneous mantle, and any early formed crust may have been either thick or thin, buoyant or gravitationally unstable, and with very low or moderate abundances of the ipatible elements. However, an initia thick buoyant crust of basalt would have transformed into dense eclogite at its base as the mantle cooled. Thus, an initially buoynnt crust could have converted to a dense, unstable crust with dine. Such a process could destcoy tire early geological rerord.

stoy the early geological reford.

Even if a form of plate tectonics began very early in earth history, other tectonic processes are likely to have been important. A magnia ocean may have formed, as suggested by analogy with lunar history, or indeed the moon itself may have formed from the earth, altering the earth's geochemical inventory. The ividespread current magmatism, rombined with evidence dual the earth has been cooling, also suggests that an extensive molten upper mantle existed in early earth history. Could such an upper mantle cool without forming cumulate layers and hence

chemical stratification?

Contcoversy exists as to whether the two largest discrete reservoirs, the core and the mantle, were ever in equilibrium with each other. The state of oxidation of the mande, as currently postulated, is incompatible with equilibrium. The upper parts, and possibly

the course mantle, may be contaminated by subducted and recycled crustal materials, particularly water. Thus, the presumed high nxidation state of the upper parts of the mantle may be an artifact of the subduction process, in any case, the high nickel content of the upper mantle seems to preclude equilibration with the core.

# Plate Tectonics Through Time

Identification of plane tectonics processes in the past depends on the assumption that we can read from the geological record the evidence that has been produced by these processes. The current assumption that ontinental crust cannot be subducted is 670 km yielding to commany geological and geophysical evidence indicating a doubling of continental crust by underthrusting beneath some monniain systems. The possibility remains, however, that observed crustal thickening it the result of squeezing of two continental masses together, with minimal underthrusting. Will it be possible to distinguish between these two types of collisions in deeply crocied ancient continental crust? Recent observations from leep seismie and electrical soundings suggest that this may indeed be possible. In a presently active collision zone, such as

that represented by the Alpine system and the Himalayas, opportunities exist for examining young and continuing orogenic phenomena. In addition to geological mapping and seismic and electrical methods of deep exploration, heat flow sublies, and applications of modern space geodetic equipment to observations of ongoing deformation should be highly production Modern collision areas may also yield chies to the nature of ancient continental terrains such as the Hercynian and Grenville, where plate tectonics has provided no convincing model for understanding vast terrains characterized by complex deformation miformly reset ages, and a rery thick crust. The apparent fragmentation of castern Asia under the impact of the advancing Indian subcontinent may also provide a model for the generation of crustal fragments such as those now bring recognized as allochthonous terrains in many orogenic areas. From the study of plate motion are taged

orer vereral million years, we have learned much along the style of place recronics, have confirmed the usefulness of the Irrnothesis that plates behave rigally on this time scale. and have formulated models to explain the cause of their motion. In the coming decade we should focus on the style of place tectonivs over time scales both much longer and much shorter than several myllion years. For time scales of 10-100 m.v., individual plates appear to have episodes of constant motion, separated by major changes in direction and velocity. Changes in direction of motion of places with respect to hot spots appear to be consistent with simple models in which places are pulled to their subslucted slab boundaries and pushed by their spreading ridge boundaries. Velocity is greater for plates with a large fraction of their boundaries attached to down-going slabs. It is important to test critically whether these generalizations hold for all Cenozoic and Mesozoic plate motions and especially whether the charge in plate boundaries causes a change in plate directions and velocities, or vice versa. Because present seafloor has been formed since the breakup of Pangea and because continental hot spot tracks are difficult to recognize, the primary source of information on pre-Jurassic plate motions will be paleomagnetic data combined with accurate age dating. We do not yet kirow whether plate recionic regimes are episodic on time scales longer than 100 m.y. Among nrany other unanswered questions are these; Was the episode of plate motions and continental

or of true polar wander? plate motion on a time scale of years or decades. A ratchet mechanism clearly perates to hold plates locally fixed by friction at active margins until the strength of crustal rocks is exceeded; the resulting rupture causes local movement and devastating earthquakes. Occasional displacement inputs are large (tens of meters and greater), and plate movements are small (a few centimeters per year). Thus, the superposition of strain events may contribute significantly to plate movements. Near acdve margins, crustal neuvements are highly ogeneous in space as well as time. Greep rates determined across vatious parts of the boundaries are both smaller and large than those predicted by existing plate models. New geodetic techniques are able to monitor plate movement and deformation over paselines hundreds or dionands of kilometers in length and are now being used for essentially continuous measurement of the relative and absolute motion of the Pacific, Nazca, North American, Soudi American, Australian, and Eurasian plate The accuracy of these measurements is a few

drift prior to the breakup of Pangea

preceded by a long quasi-static interval of

iust one continent? Is the apparent polar

breakup of Pangea the result of plate motion

ittle or no continental drift on an earth with

centimeters, so it will be on the order of a decade before meaningful velocities will be available.

Intriguing aspects of volcanism have been noted which seem to require major perturbations of the plate rectonics model. Evidence has been presented that volcanism is strongly episodic and that certain pulses have been synchronous over wide regions, including marginal progenic belts, intraplate iot spois, and continental rilts. If true, the factors governing volcanism must be global and unrelated to local conditions such as rates of subduction or seafloor spreading. Of particular interest are the production rates of roleanism decessary to generate the elevated plateau regions of the Pacific and the extensive Cretaceous episode of volcanio activity thought to have occurred in the interior of the Caribhean and in the centra and western Pacific Ocean.

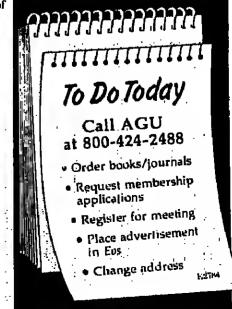
Vertical tectonic movements, though less spectacular than horizontal motions, can be easily observed and are clearly episodic on rations time scales. The gradual subsidence of passive continental margins through time can be modeled as a response to the loss of hear. But what about the interior regions of the continent? Episodic subsidence of hasins and elevation of domes within comments are well known, whereas other cratonic areas appear to have been extremely stable. Are there processes occurring at the crust-mainle boundary, causing continental thinning or thickening which would, in turn, produce elevation changes at the surface of the cominents? It appears that all plates, spreading ridges,

and trenches are in relative monion. Therefore, none of these features can serve as a lixed reference trame. The spin axis provides the only widely accepted "absolute" reference frame. Assumptions of pasi positions of the spin axis come largely from nagnetic data and from determinations of the positions of ancient equators by geological analysis of deco-sea drilling cores and by analyses of paleoclimatic indicators. The apparent polar wander paths of major continents have been determined for abstantial portions of the Phanerozoic, With hir information it has been possible to test independently the accuracy of seaffoor spreading reconstructions and to estimate the rates of commental drift with respect twither

However, the assumption than plate motion with cespect to the spin axis is identical to plate motion with respect to the mainle can be challenged if true polar wander hav occurred. If true pidar wander is to be established, absolute reference transes other than the spin axis must be defined. Proposed reference frames include hor spors thased on the assumption that hot spots originals in the lower mainle) and mathematical reference frames that minimize the motion of the lithosphere or minimize the motion of ridges and trenches. For strotter periods (years and decades) the inertial reference frame and a fixed star reference frame can be defined from satellite and astronomical data. When applied to plate motions over the last few millium years, all of these reference frames have been found to be similar, the differences being on the order of une tenth of a degree per ni.y. An important emerging problem is o determine whether the snrall differences between reference frames are significant.

#### Ninety Years of Progress

Charles L. Drake puts in perspective the problems with which we are struggling today. His essay highlights the 1892 Presidential address by Giove Karl Cilbert to the Geological Society of America as a reference point to important geological problems of 90 years ago. It is a bit dismaying tu note that many of those same problems are still with us. His closing remark "...if we are optimists, we may be comforted by the reflection that geologists of this generation, at least, will have no occasion, like Alexander, to lament a dearth of worlds to conquer," is equally appropriate today.



# Yews

### **Eagleson Voted President-Elect**



Perer S. Fagleson

Peter S. Eagleson, professor of civil engineering at the Massachuseits Institute of Fechuology, was chosen AGU President-Elect, arounding to a report from the AGU Tellers Committee on the recent elections. The Tellety region will be formally presented to the AGU Council at the Spring Meeting in Cincinnati un May 15.

Peter M. Hell, of the Geophysical Laboratory of the Carriegie Institution of Washington has been elected AGU General Secretary. He succeeds Leslie H. Meredith, Joan G. Roederer of the Geoglivsical Institute of the

sics, Thomas J. Ahrens, Volcanology, Geochemistry, and Petrology, G. Brent Dalryiu-

TABLE 1. AGU Section Election Results President-Elect

Section Atmostdierii Sciences Ciesulesy Geomagnetism and Palenmagnetism Hrdiology Ocean Sciences Planetchugs Sciswolngy

Salar-Plauciary Relations-

New Climate

Developed

operative observers

op this system.

**Delivery System** 

The Illimois Climate Center can now pro-tide information through the Chinate Assis-ance Service (CLASS) about the current sta-

firs of many weather narameters, such as ac-

communed degree days, differences between

seasonal ranitfall and parittal, and lung-range

Intore climate predictions. Illinois is the first

state for flart study a near real-time climate in-

formation system where the observations are

gathered from National Weather Service to-

designed by Stanley Changnon, thief of the

Illinois State Water Survey; Wayne Wentl-land, head of the Climatology and Metenrolo-

gy Section; and John Voxel, head of the sur-

sey's Climate Information Unit. Grants from

ral Resources and from the National Oceanic

the Illinois Department of Energy and Nam-

and Amospheric Administration (Climate

Analysis Center and National Climate Pro-

gram Office) were complete with existing Su-

vey fands and information products of the Il-

limis State National History Survey to devel-

for a Chimate Information Center for Illimis

5 years ago. This center now gathers most to

the state's natural resource data on weather

and climate into its compaters. By late 1981,

and information capally that before were dil-

In the to obtain sooner than 1 or 2 months af-

state's sast atmospheric resources will be gen-

GLASS will be usable by a variety of Inter-

ests, which follow: (1) Agricultural interests

can arcess growing degree day luler untim-

for major crops, information on insect pest

orthogaks, and soil moust me measurements

for planting and irrigation decisions. (2) En-

AGU

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Please write your member iden-

lification number on your check

or money order.

ter the Latt. Crouplex infostnation about the

crated. Carrieouly, only state agencies are ac-

cessing the data and information in a user

The Illinois Water Survey detelored a plan

The concept of CLASS was enrisioned and

John D. Hossler Suhir K. Hanerjee

Marshall E. Moss Arnuld I., Gordon Sean C. Salamun Stewart W. Smith R. A. Helliwell

Raymond E. Arvidson William L. Ellsworth G. G. Sivice (Aeronomy) Leonard F. Borlaga (Cosmic Rays]; George K. Parks (Magnetospheric Physics); llauce T. Tsurutani (Solar and Interplanetary Physics] Barry Patsons

University of Alaska, Fairbanks, will succeed

Carl Kiulinger as Enreign Secretary. The 4-

year terms for the general secretary and for-

The Tellers Committee reports that 3,964

mailed-were received by the March 30 vot-

be given to the next nominating committees.

ed in Table 1. The new section officers will

30, 1986. Each section president-clect will

serre AGU from July 1, 1984, through June

serve 2 years in that capacity and then serve 2

rears as section president. They will be voting members of the AGU Council for all 4 years.

elect will assume 2-year terms as section pres-

Almospheric Sciences, Fred D. White; Ge-

ndesy, Byron D. Tapley; Geomagnetism and

Palenmagnetism, Neil O. Opdyke; Hydrology,

R. Allan Freeze; Ocean Sciences, Joseph L. Reid; Planetology, Laurene A. Suderblum;

Scismology, Lynn R. Sykes; Solar-Planetary

Relationships, George C. Reid; Tectonophy-

Rex J. Fleming

James G. Marsh

Tahn W. Hillburg

Thomas Maddock III

Barbara M. Hickey

Secretary

On July 1, the following section presidents-

ing deadline. A list of the "write-in" votes will

The results of the section elections are list-

ign secretary end June 30, 1988.

ralid Irallors-24% of the 16,496 ballots

Teconophysics Valcanology, Geochemistry, P. Robin Brett and Petrology

Richard P. Von Herzen

and oil supplies by accessing information on heating degree clays in winter and cooling de gree days in summer. (3) Transportation ourcerns can monitur extremes of temperature, percipitation, ground frost, and snowfall to plan for repairing roads and highways. (4) Vater tesinires managers can montor precipitation accumulations and predictions to manage water systems better, [5] Air and water quality regulators can monitor the evolving conditions that affect water quality such us prolonged deliciences of rainfall or air stagnation. (6) Those concerned with natural esources including conservationists can monitor the general status of basic atmospheric conditions, including extremes of temperature, mowcover, or drought creats which have detrimental effects on the flora or failing

This news item was submitted by Stanley A. Changnon, John L. Vogel, and Wayne M. Wendland from the Illinois State Water Survey,

## World's Carbon **Budget: Sinks and** Sources

Interest in natural and man-made curbon dioxide production is siltred because it resides after formation in critical atmospheric zones. Tu determine the oncoming "greenhouse" effect, indeed to determine whether there will be a greenlanuse effect, investiga-DIS NAME Frieth to SOM up the whibal carbor cyrle. In accomming for the sources and sinks of carbon dioxide produced in the earth's surface, it has been justifiated that most of the unbalanced sources can be identified with the carth's biomass and not so much with man's combustion of lossil focis ( Ecol. Monogr., 53, 23ff, 1983). New liquies on the calculated areas of (ropical forests suggest other-

S. Brown of the University of Illinois Department of Foresity and A.E. Lugo of the Institute of Tropical Forestry, Rio Pedras, Pnerto Rico, calculated values for the total ergy interests can plan and quaiter coal, gas, bireness as 205 x 102 tons. They determined weighted birmass densides for undiscurbed clused and open broad leaf forests as 176 and 61 ions per heciate. To quote their recent report: "These values are considerably lower than those privately reported and raise ques-tions about the rock of the terrestrial biota in

> 1290, 1984). The question is an important one. If the release of carbon direxite to the authosphere can be assessed correctly, it may be possible to reduce the total amount. Concelrably, a re duttion may out delay the consequences of a

 $(1.17) \cdot 4$ 

the global carbon budget" ( Science, 223,

global mean temperature rise, but there are many unknowns in determining the purpor tions. A critical factor may be assessment of the contribution to global carbon dioxide from the biota. It is believed that recent inhalances in the carbon budget have resulted

from changes in tropical forest regions. Deforestation along the equatorial helt results in burning or produces large volumes of decaying biomass, both of which yield carling dioxide in the process. Problems arise in estimating the tonnage of biomass, as well as the amount of deforestation. There are many factors, such as wood density and lurest expansion and productivity, that are difficult to

Brown and Lugo noted that the data base available for making estimates of the biomass is limited. Instead they calculated the carbini pool in propical forests from data on the volomes of standing timber extending over a large area, which included 97% of the trupical belt area. The result is that the global carbon budget could be balanced after all.-



#### Year of Ocean

A national celebration of the oceans and their products will begin July I when the "Year of the Ocean" officially opens. A preliminary kickoff reception was held in March. The goal of the celebration is to increase awareness of the huportance of the occaus.

"It is rital that we near look toward finding workable solutions to the vast and raried issucs surrounding the wise use and management of nor seas," said John V. Byrne, administrator of the National Oceanic and Annospheric Administration (NOAA) and chairman of the board of the Vear of the Ocean Foundation. The loundation includes public and private organizations.

"The time is right to initiate new activities and reawaken Americans to the tremendous retential of this great resource," he added. The Year of the Ocean will act as a springboard to increase awareness and understanding of our treasured oceans and act as a mentral forum for shared goals and objectives

To help meet these objectives, nearly one zen roundrable discussions will be held among those working on the ocean in acadendustry, and policy making, according to Diane C. Boratyn, national coordinator for the celebration. The coundrables will be designed to facilitate collaboration among leading ocean users and policy and decision makers to raise, examine, and recommend resolutions on tonical occan issues.

Ocean Day, stated for July 1, will open the celebration, which will continue for I year with activities spousored by the federal govermment, industry, state and local governments, academia, and ocean organizations. A hye-part television special series also is being

For additional information, contact lineatyn, Box 1100, 3421 M Street, N.W., Washington, DC 20007 (telephone: 202-333-1188).

# CO<sub>2</sub> and Sea Level

There is considerable discussion corrends about the potential effects of cathon dioxide build-up in the atmosphere over the text several decades. The sinuces of information are two Government Intubal reports, one by the National Research Council (NRC), the other by the Environment Protection Agency (EPA), both were reheased within the last five mouths. The reports were described recently as being conservative, although the consequences of the resulting greenhouse effects are deemed inevitable. Armospheric warming on a global scale of as mosts as a 'C camon be avoided, only perhaps delayed by a few years at best (Eucronic Sci. Technal., 18, 45A-46A, 1984). The cause is the lutening of fossil fu els. Oil will not be too important because he supplies are predictably exhausted on the time scale of 50-100 years. Coal harning is considered as the main source of carbon dioxide. Among the more spectacular results of a global temperature rise over the dext 100 years is the expected rise in sea level of a minimum of 70 cm (German, Winter, 1983) 84). If the West Authoritic Ice Sheet breaks up and melts, the rise could be its the several meter range. Sea level tose only 15 cm in the past century.

An example of the sea level rise in Buston, MA, was given by T. C. Schelling of Hanard University (Oceanum, op. 11t.). Il mantemled, Boston and Cambridge, Massachuseus would be essemially inundated. The answer in this instance would be the construction of dikes. much as been done for a long time in Holland. This, and other examples of sea level tise and warning effects set the time of not being 100 serious il viewed on a 100-rear time scale. Man can adjust and adapt.

The EPA study is pessimistic about changing the inevitable trend. The NRC sudy sees no cause for sudden alarm, has recommende iletailed studies. One of the so far intevalualed factors is the contribution from gases ofer that carbon dioxide. Other "greenhouse gases" include nitrous oxide, methane, and chlines and there arts as .- PMR

# Geophysicists

Roger R. Rovelle, are occanographer, papa-lation scientist, and professor of science and public policy at the Proversity of California a Sau Diego, will be presented with the lifth Vannerar Bush Award by the National Science Board (NSB), the 25-member policymaking hody of the National Science Founds than, at the hoard's arrenal diruter on May 9. The award is presented from time to time to acknowledge anistandling contributions in sience and rectinology that are particidally signilicant trethe national welfare. In amount ing the award, NSB Chairman Lewis M. Bransound said, "Prodessor Rerelle's career has long been deroted to the conviction that science can make a great contribution to the wellare of people everywhere—especially the punrest people. His work is known and alnired by people all over the world, and is a living demonstration that science and humanism can be natural companions." Rerelle, an AGU Fellow, was director of the Scripps Institution of Oreanography from 1950 or 1904, and was one of the founders of both the Intergriverumental Occanographic Commission and the Scientific Committee on Ocean Research of the International Council of Scientific Unions.

# Chapman Conference on the Magnetospheric Polar Cap

A Chapman Conference on the Magnetospheric Polar Cap will be held August 6-9, 1984 at the University of Alaska, Fairbanks Campus. Conference co-convenors are S.-I. Akasofu and I. R. Kan

This conference will provide a unique opportunity for researchers to discuss various aspects of palar cap phenomena, the magnetotal sandatha effects of the interplanetary magnetic field. The magnetospheric polar cap—the highest latitude in the upper atmosphere bounded by the auroral oval—thas attracted much attention during the last several years. Discussions will emphasize an estimation of how polar cap phenomena are controlled by solar wind and the interplanetary magnetic field.

There will be invited reviews and invited and contributed presentations. The Call for Papers was published in the January 24, 1984 issue of Eos. Abstract Deadline is May 1, 1984.

Limited funding is available to support student travel. The deadline date for student travel applications is May 1, 1984. Call AGU to request a travel grant application.

For Information on the required abstract format or further meeting logistics, contact:

AGU Meeting Department 2000 Florida Avenue, N.W. Washington, DC 20009 (202) 462-6903.

For program information, contact S.-I. Akasofu or J. R. Kan University of Alaska C. T. Elvey Building Faltbenks, AK 99701 (907) 474-7282

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Replies to ails with box numbers should be addressed to Box \_, American Geophysical Union, 2000 Florida Avenue, N.W., Washingon. DC 20009.

For more information, call 202-462-8903 oc toll-free 800-424-2488.

#### POSITIONS AVAILABLE

Eastern Illinola University/Oepartment of Geography & Geology: Teaching Position in Geology. The Department of Geography/Leology at Eastern Illinois University is accepting applications for a temperary one year justified in geology starting Automost 25, 1984. Charnes are very good that this position will become full-time terms track. A Ph.D. is required. Rank will be at the asthmum professor level. The candidate will be expected to teach physical or historical geology. Preference will be given to their candidates who can teach one of more of the following: an introductory course in geophysics, concurn university, structure, Individual, and light geology. Other specialities will definitely be considered. If the position becomes permanent, teaching at summer field camp and the purmit of research will be expected.

an be expected.

The Prpartition has six full time geologists and pproximately 120 undergraduate geology majors.

APPLICATION PROCEDURES: [11 Application dealline is May 31, 1984 really completion of application is encouraged! [2] Individuals wishing to apple about immediately nigle their interest known to:

Dr. Gary Wallace, Chairman

Department of Geographs and Geology Eastern Hamis University Charlescor, Himas 61820 felephone: office—217384-2020; Juane—

(217)345-377 13t Candidater should submit the following materials to the above address as soon as possible.

All Letter of application

All Letter of application

by A current vita
c) Transcripts from all institutions from where college credits have been extract
d) Arrange for three letters of recommendation to be sent sent names, adult cases, and telephone numbers of referees with letter of application.

Eastern Illinois University is an afternative action and equal coupleyment opportunity purployer.

Software Systems Engineer. Camililate will be respeciable for the continuing development, mannerspeciable for the continuing development, mannerspeciable and improvement of major software systems which form a part of the real-time control, data processing and data recording portions of a state-of-the-an high sensitivity, high resolution traducts a term used for imaging near earth and deep space satellies. The asystem involves three general purpose compagers (Morl Yamp Classics) and two special purpose array processors. The complexity of the sistem presents a considerable clafflenge. The person myoled should be prepared to assume a strong personal responsibility for the continued improvement and operational reliability of the software warrus, and should be prepared to work unusual hours on occasion.

occasion.

Strong mathematical and engineering or phrsics background is required as well as a good knowledge of both assembly and FDRTRAN computer Languages. An appropriate backelot's degree and at least two veros of applicable experience are required. Must be capable of working with limited steperising.

Please write, cuclosing resume to: [.T. Karakat Assistant to the Director Haywark Observatory Westland, MA 19886 MIT is an equal equantimity bellinmative action

Cooperative Insultine for Climate Studies/Posidoctoral Fellowship. The Department of Meteurology at the University of Maryland, College Park hos established the Cooperative Institute for Elimate Studies (ClIS) with NOAA to engage in collaborative research. The Insulue is involved in a variety of studies oriented toward a better understanding of climate and currently has openings for three posidoctoral fellows to join with the current Institute maff. Details of the areas of study are as follows:

Shortwave Radiation Modeling: This pusition will A. Mortreaux Radiation Modeling: This pusition will involve research toward the development of a detailed rhortwave radiation metel and the application of mediative transfer models to the interpretation of radiation observations. Additional research max include radiation studies needed for the interpretation and calculation of the planetary radiation budget from satellites such as the NOAA queration a stelling Nicolary.

orage from satellites such as the NOAA querational satellites Nimbus 7 and the forthroming Earth Sadiation Budget Experiment (ERBE). B. Earth Rudnetton Budget Analysis: This research position involves analysis of the relationship of the general circulation and the annospheric energy budget to the net radiational forcing utilizing data from numerical analysis-forecast mudels, general circulation models and satellite observations of the planetary radiation budget. Both theoretical and observational appears of this inspartiant problem will be considered. C. Steady-State Chante Modeling: This presition call

C. Steady-State Chantle Modeling: This pression calls for a meteorologist with experience or interest in experiences with stearly state climate stoodels. Printipal activities will involve running experiencests with casing steady state mostels, deriving careful verification procedures, handling extensive observed data sets, tasking modifications in model communications for running the models.

Letters of application abunded by sent to:

E. Rager, Director CISC.

Department of Meteorology

University of Maryland

College Park, MD 20742.

Applications should include a curriculum vitac and names of three references. Applications received before May 15, 1984 will reveive full consideration.

The Privacelym 13.3.

he University of Alaryland sobscribes to a policy of equal educational and employment opportunity. The University of Maryland, under Title 18 of the Education Amendment of 1972, does not discriminate on the basis of sea in admission, treament of sudents or employment.

Air Force Geophysics Laboratory Geophysics Scholar Prigram (1984–1985). The Air Force Teophysics I alicultory CAFGLI and The Southeast-crit Center for Hervical Engineering Filication (SCFF) amounts of the amount of the population are mored for research appointments during the 1981–1985 year in the Leophysics without Program. This program provides research opportunities of the 12 months duration for selected Figureers and Scientists to perform Leophysics of the AFFGL Hairston AFFGL grant for the AFFGL Hairston AFFGL grant for the AFFGL Scholars will

com ACII, near Boston, Massachusen's Scholars will be selected pomards from such fields as Lemphy-us, Armospheric Physics, Meteorology, Ion Chemis-ty, Applied Science, Mathematical Modeling using Computers, and Engineering To be eligible, carniglates must have a Ph.D. or comvident experience in an automatic back of all To be engible, cardidates must have a Ph.D. or copusation experience in an appropriate to bineal held. Some appointments may be continued prior to August 1983 so early applications are encour-aged. All qualified applicants will receive consider-ation without regard to tace, color, religion, sex, or national origin. Application Benefitie for September Appointments. August 1, 1981, For further infor-mation and application forms contact SCFF, 1401 Massachusetts Avenue, SCF bond, FL 12769 Tele-phone, (1974) 872-613.

dione, Frita 202-01-00 SCFFF supports Equal Opportunity Albumatise

Scientia/Engineer. The Havstack Observatory is serking a Scientia/Engineer to work in the held of Very Long Baseline Interferometry (VLB). The Scientia/Engineer would assist in the development of new YLB1 data acquision electronirs at well as assist with the processing and analysts of data taken for the NASA Critical Dynamics Project. The applicant rhould have a Ph.D. or its equivalent in tadio autonomy or a related field. Since engineering knowledge and experience with electronics is needed and a knowledge of computer and microproressor programming would be an asset.

Please write, enclosing resume, in:

[T. Karaku
Assistak Observatory
Westford, AlA Olasso
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Electronic Engineer. The MIT Harstack Discrictiony has an opening lot an Electronic Engineer to design and develop electronic equipment for Radiometrici and Very Long Baseline Interfetometer (VLBI) measurements for radio astronomy and geodetic applications. Dunies include design and communition of RF systemy using mixers, tooled parampt or mater amplifiers, as well as IF systems, frequency multipliers, PPL's truchronous detectors, etc. Person will supervise construction, test and integration of such new equipment and document all sections. dly participate or observatory experiments with sci-

enturs.

Applicants should have a B S, in Flectrical Engineering or Physics and M S or equivalent is desirable but not mandabory. Person should be landlar with the design of interowave circuits upolying want the design of the powder circuit the good base-guide and associated components. It at good base grounding in the nx of amplifiers, mixels, modulation and mose, etc., should be added the prioriples of solid state and digital (i) in design prioriples of solid state and digital (i) in design but years relevant experience is desirable. Two to her years relevant experience is destrable, but a promising new grathane will be consultred if there is reasonably applicable hardware experience during or before school. Abbits in work well with esternal Previous inferest in a grouping to

others is esteptial previous me beneficial but not responsel. Please write, enclosing retinne, to. J. T. Karaku Assigam to the l'irretor Hustack Ubserrator Westord, MA 01880

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University of East Anglla/Lectureship in Geophys-iral Fluid Oynamira. Applications are invited for a "New Blond" letter eship in the School of Mathe-matics and Plusics. The cavisaged held of research is vacan-ise late interaction to keyand to the dynamics of the manginal ice zone. Preference will be given to applicants with research experience in geophysical fauld dynamics or ice-flow dynamics or dynamical ocentography. Salarr will be on the scale of £7180 to £1-125 per attentity funder teview) plus USS benefits.

benefits.

Applications (three copiest which should contain a full curriculum vitae, including exact date of birth, negether with the names and guidresses of three persunction whom reference may be nonle, should be briged with the Evaldishment Officer, University of East Anglia, Norwich, NR4 77], not later than 14 May 1984. No forms of application are issued. In maning three referees you are particularly requested to give only the names of those who can immediately be approached.

## GEOPHYSICIST

Faculty position in Salamology/New Mexico Tech. New Mexico Inelitute of Mining and Technology Invites applications for a tenuratrack position in Salamology at the Assistent Professor level. The PhD is required. The position is a joint appointment with the College Ovicion and the Geophysical Rasearch Center in the Research and Development Division. New Mexico Tech has had instructional and rasearch programs in Geophysics for 3 sion. New Mexico Tech has had instructional end research programs in Geophysics for 3 decades, end confere BS, MS, and PhD degrees in the lield of Geophysics. Much of the geophysical research has been, and continues to be, related to the determination of the physical characteristics of the Rio Grand Rift a major continental tilt in which Tech is localed. We currently operate a 14 station seismograph network (ightilty with the U.S.G.S.), as well as a 3-component long-period station. In addition, studies of the crust and upper-mantel structure are underway with portable sasmograph systems using both earthqueke and explosive sources. The geophysics staff and instructional program are part of the 18-member Geosciance Department, which also includes the disciplinas of Geology, Geochemistry and Hydrology. The instructional and research ectivities of the Ospartment and Interest Research and Development Citylson. In addition, several of the Tech staff heve colleptrative research projects with personnal leborative research projects with personna from the nearby Sandia Nellonal Leborator from the nearby Sandta Neilonal Leboratory (Albuquerqua) and Los Alamos National Laboratory Sand letters of application, tasuma, and a brief description of leaching and research Intersets to: Allen R. Senford, Gaosciance Department, New Mexico Tech, Socioro, NM 57801.

Equal Opportunity Allimative Action Employer.

Staff Opportunity: Geophysical Laboratory/Carnegle Inatiution of Washington. Privately-endowed, lattic-reward and educational organization

dowed, hater-reward and ethicational organization seeks containding scientist with broad interest in the veloping the principles of Element Concentration. Applicant's background capecially should include experimental experience involving a write range of bresures and temperatures, theory of mass and train anyport, and held aspects of our deposits. Familiarity with stable-indope reward desirable. Creative and mnovative qualities essential.

Since stall applicate will be appointed Farth Sciences Research Scholar for a period not to exceed threy years. After demonstration of leadership and excellence in research, the Scholar will be eligible for a regular stall position. Modert fronts are available for technical support of the Scholar's work.

Applications now being accepted by the Director, Geophysical Laboratory, 2801 Djuran Street, N.W., Wathington, H.C. 20108. Submit 3–5 page summary of proposed rewarch program, curricultum time viace. Watington, 11.5. 20008, Silbutt 3-5 page outmina-ty of proposed research program, curriculum vitae, three letters of recommendation from persons cho-sen by applicant, and completed Application Form obtainable form Executive Serretary. Starting date is about 1 July 1981 and is negotiable. The Carnegle Institution of Washington is an equal opportunity and allumative artism employer.

Faculty Postilon/University of Montana. The Lecology Department of the University of Montana is uroning applications to fill a temporary one-year position at the Assistant Professor level (contract period will be from mid-September 1981 to carly function will be from mid-September 1981 to carly function of substitution of substituti

Those interested should send a letter of application, resource three letters of recommendation to Anold J. Siberman, Chairman, Bepartment of Grodoy, Pairersity of Montana, Messania, WI 5981; The DYADIAN tot applications is May 15, 1984. The University of Montana is an allumative acաթգրվ օրասանչ շայնութ.

Assistant Professor Position/Theoretical Physics.
The Physics Department at the University of Houston expect to tell several jenute track position in theoretical physics at the avisant parolessor level The first of these may be libed in the hall of '84. The areas of interest are Condensed Matter, Non-Linear Departmes, Plastia Physics frightling Space Plastias) and Statistical Mechanics. Our interitors is to combinate interfacilities acres is when these bresidy defined areas. It is desirable that randichare have an interest in interaction with other mend of the throny group and the experimental pro-

Send resumes and three leners of reference to George Sener, Physics Repairment, University of Houston, Houston, TX 77001. The University of Hoston is an equal opportunity

M hieralogy/Department of Geology, University of Oregon. A position of Visiting Assistant Professor of Vicingy Will become actual de on September 15, 1984. The successful candidate should have restarch interests in the general held of mineralings and crystallegraphy and of the recognitor to teach the one-teaching of one or more courses in specialized areas of mineralogy to encouraged.

Departmental research bacilities of interest to a mineralogist include UV-IR spectropholometers, electron probe, SEM, nontrun activation analysis, AA, X81, X81, and a high-resolution X-ray emission spectrometer.

AA, XRI, XBI, and a ingui-resonation X-ray consistent spectrometer.

Applicants should have a doctoral degree of latve substantially outpleted the requirements for it before taking up the appointment. Send curriculum ritae, bibliography, and statement of research interests, with namer of three professional referees in May 15, 1984 to Chairman, Mineralogy Search Committee, Department of Geology, University of Oregon, Eugene, Oregon 97403.

Salary dependent on qualifications.

Salary dependent on qualifications. The University of Oregon is an Affirmative Ac-tion/Equal Opportunity Employee and complies with Section 501 of the Schaibliation Act of 1973.

with Section 501 of the Rehabilitation Act of 1973. University of Wisconsin-Milwaukee Faculty Position in Atmospheric Sciences. The atmospheric sciences program in the Department of Geological and Geophysical Sciences will have a temore trark position supported by state lunds at the assistant professor level starting in September 1984. The applicant most have a PhD in meteorology or atmospheric science or a related field. Preference will be given to those who have a good publication record and/or posidoctoral experience. The surcessful applicant will be expected to develop a strong research and gradoate program, and to ceach undergradoate meteorology courses starting at Ireshutan level. In the undergraduate major area, he so she will teach courses in advanced dynomics, mesoneteorology and nesoscale modeling, in addition to courses related to the held of expertise. Usually two courses to credit hunrs) are assigned per semesier.

Research opportunities at UW-Milwaukee include satellite incteorology, severe storm dynamics and energetics, diagnostic modeling, large-scale circulations and energetics, sproptic meteorology and unmerical modeling. Research Tacility, Urban Research Center, and a rural lield station. Interested randidates should forward rheir resource to: Professional designation and consequence of Professional Center, and a rural lield station. Interested randidates should forward rheir resource to: Professional contents and contents of the professional contents and contents of the professional contents of the professio

randidates should forward their resume to: Prides-sor D.N. Sikdur, Chairman, Scarch Committee, De-partment of Geological and Geophysiral Sciences, UW-Milwaukec, 1900 E. Kernwund Blyd., Milwau-UW-Alilwankee, 1900 E. Kenwand Blyd. Milwankee, WI 53211, with three leners of recommendation from professors and scientists well acquainted with the applicant's education background and research patential. Clusing date for applications is 21 May 1984.

UVM is an altirmative action/equal oppurtunity

The Colorado School of Mines. The Department of Geophysics of the Colorado School of Mines expects to have an upcoing for the academic year 1981–1985 for a cardidate with experience in Gual 1981–1985 for a conflictate with experience in Gual geophysics, carthquake scientedogy or selsmic risk. The Oepartment emphasizes geophysical exploration and applied geophysics; and preference will be given to the candidote who can bring that emphasis to his particular field of expertire. An extensive soite of field equipment and comprises is available to support research projects, and the Department operates a science observatory that is part of the projects who expert they the imposite the control was expected to the control. operates a selamic observatory that is part of the world-wide network. We expect that the appaintment will be made at the Assistant Professor level; however, an accomplished sciential with a background in one of the areas of interest coold be considered at a higher level. Please send applications, resumes and/or inquiries to: Philip R. Romig, Professor and Heal, Department of Geophysics, Culutado School of Mures, Gulden, Colorado 80401.

The Colorado School of Mittes is an aftermative action/could opportunity employer.

Old Cominion University/Physical Oceanographer The Department of Oceanography seeks candi-The Department of Oceanography seeks candidates for a newly created tenuce track laculty position. Of particular interest are scientists with experience autor micrest in hoth held work and geophysical fluid dynamics. The successful candidate will interact with an on-going observational program and should thow strong potential for descloping his/her own goalcase teaching and funded rescarch programs. Off is a state-supported university, and the growing Oceanography program currently has 15 laculty and 70 graduate students. Although we anticipate hiding at the Assistant Professor beyel, cientus with more expecience are encouraged to apply. Salary will be commensurate with experience. A Pa.D. is required. Apalicants should saladic a curriculant vita by June 30, 1084 for Dr. Donald R. Johnson, Search Committee, Pepartulent of Oreanography. Old Dominion University, Norfolk, VA 29508.

Old Dominion University is an affirmative action?

Old Dominion University is an affirmative actions

Posidoctoral Fellowship In Experimental Petrology at UCLA. Available September 1, 1984, Uarricates should be accomplished in thermodynamics and to synthetic phase explibition of low aird high pressures; knowledge of X-car crystallography, electron microprobe spectrostry and lield occoreacts of to k-forming trimerals also requised. Please send vita, short summary of research goals, and two letters of recommendation by June 15, 1984 to: W.G. Ernst, University of California, Department of Earth and Space Sciences, Los Angelec, California 90024.

UCLA is an affirmative action/equal opportunity

Instrumental Analyze/UCSC. (Statt Revearch Associate 111, Joh #84-49313) Fullitine permanent. Hories: Management of automated NRF Spectrotocity Lab. Duties include equipment maintenance, joint responsibility for rabbi adon and quality control, we ten development and instruction of overs. Opportunity exists for personal research, Response B8 in natural stocker and two years relevant expertence of MS. Spectroscopy theory and programming experience desired; Vicosledge of NRFS and FOR CRAN preferred, Salary \$1,860 per mouth Apply by May 1, 1984 no: Unicoersity of California, Santa Cruz, Personnel Department, 109 Communications Budding, Santa Cruz, CA 974041.

Postdoctoral in Field of Planetary Atmospheres.

Matt squamer '81 for 12-month approximent, probably renewable, \$17,500. Preferred research inerrors: upper autocopiere aeronomy (exception electric), dimate modeling, radiatise transfer Send vine to: Portesson J.W. Chamberlam, Space Physics and As-tronomy, Rice University, P.O. Ros 1892, Florenti, TX 77251.

#### **POSTDOCTORAL** RESEARCH **SCIENTIST ATMOSPHERIC** RADIATIVE TRANSFER THEORY AND COMPUTATION

Tha Theoralical Division of the Los Alamos National Laboratory has avaitable a posidoctoral research appointment for work on modaling tha almospharic radiation balance for climatology epplications. Individual should be interested in and qualified to davelop new computational solution tachniquas for the radiative transfer equation.

Scope of work:

Knowledga of computational mathods to analyze solar radiative Iransfar through the atmosphare and axperience in FORTRAN programming and handling of larga dala libraries is desirabla.

The position offers opportunities for use of our large computer facil-Illas, for exciting intardisiplinary resaarch, and for collaboration with other research teams.

Los Atamos National Laboratory is operated by the University of California for the Dapartment of Energy. Our location in the mountains of northam New Mexico offers a clean anironment and ample recreational activitles. Postdoctoral appointments are for one year and may be renewable for a second year. Candidates no more than three years past thair Ph.D. are invited to apply.

To apply, send a resuma and a briaf latter describing your research interasts lo:

Dr. S. Gersli, DIV-84-AY Theoretical Division MS B210 Los Alamos National Laboratory Los Alamos, New Mexico 87545

Iniversity of California



Screening Committee value address, phone (317) 491-9100.

An Equal Opportunity Afficiative Action En-

Postdoctoral Position in Upper Atmospheric Phys-ics. A positionerial position is available in the Spare Phesics Research Laboratore at the University of Michigan for a qualified candidate with a Ph.D. of Michigan for a qualified candidate with a Ph.D. elegree and experience in Opper Atmosphere Physics. The position intolies the analysis of state obtained from two instruments flown on the NASA Demanic of Fydoren 2 satellite. The estensive satelline data base provides detailed information of the Demanics. The modylamics and Compositional Standard of the Neutral Paper Atmosphere. The appointment will be for one coar tremwalder and in utant in October, 1984. The applicant should identify and describe areas of this or her expertise that can amount theoretical increasenions in Crone. plentify and designed areas of the order experies that can support theoretical investigations in Upper Amosphere Physics. A resume and the names of three persons knowledgable of the applicant's experience should be forwarded to:

16: 1.1. Kilbeen

Space Physics Research Lab.

Department of Atmospheric and Design Sciences.

The University of Michigan.

Ann Ador, MI 48009-2113 The Poisersity of Michigan is a non-distribulators allumative action employer.

Uniscuite du Quelice a Rimonaki, farulty Posi-ilon, Full-ilma Peofessar of Geological Oceanogro-phy. FUNCTIONS: The successful camildate will be transful to acade in moreograf the multi-oceanography. FUNCTIONS The successful cambidate will be trapided to teach runners at the undergraduate breef and in the master and Ph.D. oreanographs programs. He will be espected to collaborate with existing research programs in the helit of benthin-boundary larer biogeorhemismy and roastal sentiment denanties, and of to elaborate and develop a new research held in geological occanographs and to develop new courses in own array of specialization. (REQUIREMENTS The servership carticipally low equivalent with specialization) recent marine selfment All applications will be regarded marine selfment All applications will be regarded confidentially. Interested persons should setal their curtimination (the before May 18, 1983 to), Jean Lebel, Directors, Departement (Cocamographic). Dureitur, Departement (l'Occamagraphie. UNIXERSLIF, 10 : QUEBIC, A RIMOUSKI, 2001, arve dec Prisidines, Rüpigiski, P.Q. 1651 J.M.,

Scientist Station Physical Aualyst for Supporting Remote Sensing Experiments & Data Apolysis. Areas include: 1) development and approlation of Gacking algorithms for satellite alimeters for

ocean topography & seriam mapping, 21 analysis of utmosphern (ozone estimations Sasos) or radianon transfer measurements (rom rocker & lulboar with mean suctace with application to meaning capholic libra experiments. Minhaum requirements: published or prepared reports in one of these areas alone, limitiar with Monte Carlo methols of radiathan transfer studies. Three certs experience, Phil Physics of Electrical Engineering, 40 hours/reek, 8– 4-30 \$770/seek, Lucation: Wallops Idand, VA, Tu apply send resume with ropy of ad analyst for pover Spruil, Virginia Employment Commission, 51-15 East Virginia Brath Bleth, Norlok, VA 23502, 1-0, #1074078.

University of Arisona/Tondem Accelerator Mass Spectrometry. A position is available for a junior in experienced positional scientist at the National Science Francision teaching for Radioonope Analysis at the University of Arizonal. The lacility is uned purmardy to detect and analyze the prevence of "C. pennarily in detect and analyze the presence of <sup>10</sup>C, <sup>10</sup>Re and ofter trace todopes in samples of scientific interest, and for tenarch on applications of accelerator mass specificancers. Ball of the time on the Facility is reserved for collaboration with off-sine users, and the other half is used for in-house research programs. The person lined for this position cill be responsible for places, appears of the landem actrication and associated equipment, and still have the opportunity to develop research programs unbizing the Facility, Salary will be commerciante with esperience Academic now. Compact Professor D. J. Dourhoe, Department of Physics, University of Arizona, The University of Arizona is an equal opportunity afformatic action employer.

Marine Research Associate III. Putdoctoral posi-tion a two-text positiocloud research associate posi-tion available intirediately, for studies of the westnon available infinicliately, for smoller of the wear-cin Nargason Sica from the subtropiral convergence to the Gulf Succam. The research incolless micgra-note of current meter, hedrographic and XIIT data with suching the enal IR digital data. The primary scientific emphasis will be on threscale mean surface demandes and con an sea interaction in the region. Facilities nothing a VAX 12-750 with a sophisticated intagr processing system forbidated to project a large-lustorical digital data hase and extensive data ampli-sition program of the Western North Adamic Sent ressums and three tradesional relations of North resume and three professional relearnees by Mac I. 1981 to Bariel L. UGOS, Martine Research Associate III position. THE UNIVERSITY OF RHEIDE IS LASD, P.O. Ros. 157. Kingston, Rhode Island An AATOL mit

Southwest Research Institute/Inn Mass Spectromatry. A senior stall position is a tailable in the Southwest Research Institute's Department of Space Sciences for a Ph 11, here experimental physical to conk in space Joine for neares spectrometry. The successful applicant will have the opportunity to the teleprom mass spectrometras for spacetral independent in the taility magnetosphere as well as to comer and planetary magnetosphere as well as to comer and planetary magnetosphere in magnetic ion mass spectrometry and monococharmed-plate imaging distributions storens. Contact [1] Illimb. Southwest Research Imagine, 215 Drawer 285(0) San Autonio, TX 78281, telephone 512-681-5111, estersion 2526, or Illif Crimileit, Porsonne) Department, extension 2672.

#### POSITIONS WANTED

Occanographics, Ph.D. Extensive experience in the measurement, analysis and interpretation of smilliferplinary occuring raphic data. Third virinia and principal divertigative late many research projects. Marine environmental impact assersment. In a project of the control of th inatine pullution, underwater assussics. Publica-tions. Introcyced in retearch and/or managetial posi-tion. P.G. Box 55373, Scattle, WA 98155.

# William L. Chameides: New JGR Editor



Maintaining high quality of papers while decreasing review time is among the goals set by Journal of Geophysical Research colitor Williant L. Chameidee, associate professor at the Georgia Institute of Technology's School of Geophysical Sciences. On January I Chameides officially began his 4-year term as ediint of the section of the journal that emphasizes atmospheric chemistre and physics. He succeeds Ralph J. Cicerone.

Chameirles says he will follow in Cicerone's tradition by maintaining the high quality of the juntual and the broad scope of papers published relating to atmospheric science. He bones to broaden further the journal's scope by incorporating more multidisriplinary papers. Increasingly, annospheric scientists are becoming enucerned with problems relating to hingeochemical creles, global pollution and climate, global hubitability, climal physics, and acid rain, Chameides explained. The suhitions to these problems, he added, will renuire the collaboration of scientists with capabilities in a wide cariem of disciplines. It is Chanteiles' hope that JER will serre as a lorun for the exchange of ideas and new finitings among this broad and multidisciplinary community of scientists.

As another war to broaden the journal, the editor also platts to include papers on new instrumentation and sampling techniques for gathering atmospheric data. In the past, said Chameides, papers dealing with new tech-niques were usually published in journals specializing in instrumentation, journals not widely read by atmuspheric scientists. By pub-

<u>Meetings</u>

June 22-26, 1984 Practical Applications of Groundwater Genthemistry, Banff, Alber-

ta, Canada, Sponsors, the Alberta Research

Council and the National Water Well Associa-

tion, [David Nielsen, NWWA, 500 W. Wilson

The conference will feature formal lectures

Bridge Road, Worthington, OH 43085.1 Registration tleadline is May 15, 1984.

on "Fundamental Aspects of Groundwater

talks on "Groundwater Geochemical Methods

Applied to Specific Field Problems Presented

by You." There will also be a number of con-

current panel discussions on "Application of Groundwater Geochemistry to Solve Prob-

The conterence will be limited in 300 partici-

pants and will take place at the Banfl Springs

American Astronomical

October 9-12, 1984 Hith Annual Meeting

of the Division for Planetary Sciences of the American Astronomical Society, Kailma-Kona,

Hawaii. Sportsors, the Hawaii Institute of Geophysics and the Institute for Astronomy

of the University of Hawaii. (Fom McLord,

time of Geogshysics, University of Flawaii.

2525 Datrea Road, Honolulu, 111 96822.1

Abstract deadline is August 10, 1984.

Contributed reports from all areas of planclary science are welcome. Abstracts in the

standard AAS format should be postmarked

Plan for San Francisco now. The AGU Fall

The 1981 Fall Meeting will also incorporate

the winter meeting of the American Society

Meeting will be December 3-7, 11084.

of Linuology and Oceanography.

hy Angust 1 and should be sent to the pro-gram chairman, Tom McCoul, at the above

Plan for AGU Fall

Meeting

Planetary Depositences Division, Hawaii Insti-

lems of Practical Interest to Participants."

Geochemistry" as well as a series of short

Announcements

Groundwater

Geochemistry

Hotel, near Calgary.

Society

these new techniques can be rapidly appraised by atmospheric research scientists. the people who are most interested in their

To foster communication among scientists in different disciplines, Chameides suggested that following the table of contents in each isone of the atmospheric sciences section of IGR should be a list of relevant papers appearing in the other sections of JGR. In this way, he explained, atmospheric scientists would be alerted to papers of interest in the other sections. This is particularly important for papers touching on the interlures hetween ocean and atmospheric sciences.

One administrative change that Chameides has instituted aims to decrease the review time to 5 weeks. Before sending out a submitterl manuscript, candidate reviewers will be relephoned to ascertain whether they have the time and inclination to review the paper within a teasonable period. If the potential reviewer can do the review, the manuscript cent out; if not, another reviewer is queried. All editors follow this practice.

As a first for JGR, the new editor plans to publish as a special issue the proceedings of the forthcoming Serenth International Conference on Armospheric Electricity.

Chameides current research interests in clude theoretical studies of the composition of planetary atmospheres (including tropospheric gas-phase and aquenus-phase chemistry), biogeoclicinistry, and atmospheric electricity. He was one of three recipients of the 1983 AGU James B. Macelwane Award in recognition for his contributions to the genphysical sciences (Eos, August 2, 1983, p. 489). Chameides receired a B.A. degree in physics in 1970 from the State University of New York at Binghamton. He received an M.Ph. degree in 1973 and a Ph.D. in 1974 from the Vale University department of gealogy and geophysics. He has been an associate professor at the Georgia Institute of Technology since 1980. Before that, he was an assistant professor for 4 years in the physics and astronomy department at the University of Florida. While there, he was awarded the Sig-

ma Xi Faculty Research Award. When not busy with his research or with his editorial duties, Chaqueides can most often be found at home with his two sons, Daniel and Michael. He also enjoys reading liction, playing baskerhall, and going to the

The meeting will take place in the Sau Francisco Civic Auditorium. This building

neous sessions needed.

will house untder one roof all of the simulta

To avoid as many conflicts as possible, a

large number of poster presentations will be scheduled. Program chairmen will be plan-

ning special poster sessions, and authors will

be encouraged to present poster papers. The very large arena in the Civic Auditorium vill

make an excellent site for the poster papers.

This arena will also provide space for a sulstantially larger exhibit than has ever been

seen at a Fall Meeting, and the refreshments

the San Franciscan Hotel, and the Holulay

Inn-Ciric Center. The latter two are year the

Civic Auditorium. Shuttle buses are planned

for those who cannot or will not walk from

the Holiday lun-Golden Gaterray and Cathe-

The formal Call for Papers will be pull-

lished early in the summer. The abstract deadline will be in early September. Housing

and registration information will be pul-

**Pacific Northwest** 

The 3llth AGU Pacific Northwest Regional

Meeting was held September 29 to October 1,

1983, in the campus of Western Washington University, Bellingham, Washi, Approximately 125 attended the meeting, and 36 papers were presented. The meeting included two fields tring five special symposium and a house field symposium and a symposiu

fields trips, five special symposia, and a ban-

The meeting highlights included a symposium on Tertiary sedimentary basins of

Washington and Oregon which revealed the

importance of sedimentological studies for

deciphering the timing and nature of accre-

tionary processes in tectonically active areas.

Geological and geophysical studies on the re-cent tectonics of the Juan de Fuca plate and

nearby continant were presented by workers

from the United States and Canada as well as 1 camposition, supporting the interposit

quet where keynote speaker Don Swanson

presented "Dome building on Mr St. Hel-

Meeting Report

**AGU Meeting** 

lished in early fall.

and registration will also be in this area. Flousing will be primarily at the Cathedral Hill Hotel, the Floliday Inn-Golden Fateway.

Questions about the journal, rounneuts. aggestions, and papers should be sent to William L. Chambides, Editor, JGR, School of Geophysical Sciences, Georgia Justimie of Frehmology, Atlanta, D.A 30332, Changelder term as editor ends December 31, 1987,-

# AGU Membership **Applications**

Applications for membership have been re-reited from the following individuals. The letter after the name denotes the proposed primacy albhation

Sugranto Amiricandi (11), Walter Bawiec (V), Nathan E. Bisler (11), Susan Burke (O), Chung Chan (SM), Richard B. Codell (11). Trene P. DePalma (D), Reinhard E. Flick (O), Kristen E. Franz (11), Uhien-Uheng Fu (O), Hiroyuki Fukucama (V).

Pieter M. Grootes (V), Eiji Ito (S), Steve rpe (S), Buenjamin Kartawiria (H), Terri E. C. Keith (V), Douglas R. MacAyeal (O), Masamichi Miyamoto (P), Cyuthia A. Moncreiff (D), Jahan Nuorishad (H), Coert Ohisted (SM).

Robert G. Rader (O), K. Ramachamban (H), Dede Rasvid (H), James C. Ratte (V), M. M. Sarin (V), Dieter Seidl (S), Atula Senarame (H), Ulrich Siegenthaler (O), Ellen J. Steiner (A), Thurkild Thomsen (H), Oester A. Tiliem (H), Barbara Valentino (T), Francisco P. J. Valero (A), Aldo V. Vecchia (H), Biquan Wang (S), Ken Watson (H), Catherine Willis (14), Kenneth Winnick (O), Bao-Zhen Zhu (A).

#### Student Status

Craig Brinting (St, Christian P. de Mouster (10), Marrin Dougherry (1), Kerin Robert Durkee (A), Shellet Bron (V), Vicki Harder 1T), Jene Hendrickson (11), Ken Herkenhoff (P), Claude M, Laird (SA), Shaun Larsen (Ga Xiang-Dong Li (S), Rith L. Lindslet (P), Jeffrey E. Lucius (GP).

Mark L. Morrissey (A). J. Daniel Moset (SC), R. Jan Perry (C)j, Manifecti L. Rayant (O), Steren I. Recra (V), Bruce A. Sarage (V). David R. Scott (1), Lauberk Slitea (G), Phric Sweazy (P), Robert J. Larlot (14), Mark Walk-

ongoing studies for the evolution and charac-

Conference Center at Western Washington

University for handling the logistics of the

This weeting report our prepared by David C. Entgebretsont and Myrl E. Beck, Jr., Department of Geology, Western Washington University, Bel-

Minoralogic Terreina and Tostonic Timing --Quimpar Ponincula, Northogst Olympic Peninsula, Nashington

JOHN M. ARMEMFROUT, Mobil Exploration and Producing Sarvices Inc., P. O. Box 900, Calles, Taxes 75221

Eccone stratigraphy of the Quimper Paninsula area consists of two adjasent cleareingically distinct terrains separated by a fault sons and unconformably overlals by a third mineralogic terrain.

unconformably overlais by a third minaratopic tarrain.

Lower through Middie Eccene [Penutian to early tower through Middie Eccene [Penutian to early Marizian Foraciniferal Stagos] arboais aandsiona of Scow Bay occurs asst of the fault aons and has peleocurrent factures suggesting a aadiment source are to a the south or southeasi. Lower to Middiu aroa to the South or southeasi. Lower to Middiu Eccane (Penutiae ta Ulatisian FormanialTeral Stagos) Craacunt formaclon theisittic basaits und tocatly durived basaitic sandstone of Haynard occur wast of the fault aona. Unconformably overlying the above units is Upper Eccene (Refuglum FormanialTeral Stagos) Quimpar Sandatona, a marine ithic andstone with abundant plaglociosa and basait grains suggestions.

with abundant plaglociase and baselt grains suggesting local grosion and mixing of both underlying them to Middia Eocana oineralogic terrulna. These raistlanships suggest that the western baselt terrain was juxtuposed against the asstern arthaic terrains und both terrains upificed and actively terrain und both terrains upificed and actively uround by early tate Eocano (Pafuglun Foraminfersi Stago) tice approximately 3B Ma.

Iha fault aona, mopped west of Andersan istemate the fault aona, mopped west of Andersan istemate baselt against a agamunt of the Olacovery Say Fasit system, and passibly represents a toctomic suture batean accenic incisitic beselt terrain and cratonic artosic terrain.

Gaochemistry of the Crystalline Core of the Horth Cuscadae Range

R.S. BABCOCK (Geology Dept., Mestere Washington University, Beilingham, MA 98226)
P. HISCH (Dapi. of Geosciencas, University of Washington, SEattle, MA 98185)
R.t. ARMSTRONG (Dapt. of Geological Sciences, University of British Columbia, Vancouver, B.C. 1957 284)

sily of British Columbia, Vancauver, B.C. V6F revisit of British College of British British College of British Britis

ter of the crystalline North Cascades of

Washington and British Columbia. Special acknowledgments must go to the

fixghon, WA 98225.

Abstracts

# Students Take Advantage of Student Membership | in the American Geophysical Union. · membership in an inter-

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geophysical sciences

is a lower grade stratigraphic aquivalant of the SGC. Melamorphis leucosomes of migmatitus in the SGC ara paraluminous trondhjenicus that ara mora sodit and silisic than melaluminous orthognalasas, intrudad prior is, or during, the main atogo of metamorphism, ine Eldorado Orthagnelas is also well foliated and relatuminous, but is of grandoloritic to tonelitic enoposition. Branitic dikes which cut the main-stage SGC migmatilus have the same belineation as their well-recks and yield a Rb/sr NR ago of 45 t 0,9 %2 with a low initial 5r ratio of 7040. The trondhjenitic Marbia Creak orthognaliss, associated with tha tRS, appears to be of similar age (or alightly youngar), but is mare sodic and has a higher 87/85 5r ratio.

# he Tactonic Sotting of the Mohlaeang formation (Late

MILLIP K. 610ELOX [Wastern Washington University, Bol-lingham, Wo. 90225) [Sponaor: C.A. Sucaak)

The Hontonano Fm., a maring shelf unit in southwest reshington, is unique because of its lack of correlotive marine strata in the state and because it shows characteristics of but tectohic terrenos. The formation wibits the dominance of a marpinal beain adjacent te on active oragen, it., the Olympis Humteins, as well as a form-are basin to the west of the Cascode 47s.

Patrolools results show a mixed source. Sedimentary stasts of the Olympis core and basalic clasts of the Carcool fa. Show varying dagress of low-grade matamorphism, petrooraphic textures, and weathering, indicaling a deeply inclised source of relatively large area to the north. Folsis slosts and glass whords suggest to art-derived source from the most. Sort in progress will define distinctions with the underlying Astorio [7] fm., a unit that has similarities with the Unitedant in sections, but is generally quite different in sedimentary texture. Those distinctions tould halp to identify hontoneous and Astorio [7] strate further to the south, where outcrop distinctions are less clear.

Clasts of the Asioria(?) Fm, indicate that uplift of an Olympic aburce area had occured sarifer in the middia Miotena, although on a much amaller scale than during the late middle Miotena. The fatter relationable is artichated by a rogional unconformity of the contact between the Monteagno and Astoria(?) Formations.

Lions.

Olympic orogenesia may therefore heve proceeded as a sarias of pulses in the middle and late Miccans. Long periods of quiescence are indicated by the desinishity Sandy mudatons and occasional coarse-gretand influe of the Astoria!?) Fm., culminating in orosion and interest deposition of sobrear-greined Monteann sediments. Further unlift occured in the Pilocena.

### Structure of the Grays Harbor Basin on Evidence for Foat 12 H.Y.B.P. Tostonic Activity in S.W. Washington

PHILLIP K. BIGELOW (Western Washington University, Bal-lingham, Ma. 98225) [Sponsor: C.A. Oucack)

he Grays Marbor Baaln occupies a depression atructurally controlled by middle to late Ecosme banks of the Greacent Fm, and equivalent rocks in the Black wills, Ooky Mills and the Willape Mills. This Ecosme beasement forms a broad syncling with a general plunge to the west.

Later atrustures record distinctive styles and ages of faiding and faulting withing the beain. Later middle Macune folding created a smaller Grays Marbor Beain. Major northeast-treading faults with a strong right-lateral strike-stip component are found in strute older than the Montesamp Fm. a late Miocems sedimentary wall. Mumarous Smiler associated northwest-treading normal faults are found near the lurger faulte.

Structures younger than the Montesamp Fm. (CL2-9 nyb.). are less common, but record significant

Structures younger than the Monteanno Fm. (<12-9 m y.b.p.) are less common, but record significant sovement. Large morthwest-tranding faults with left-letwal strike-slip are common in the northere basin. Thus faults can represent strike-slip movement on older narmal faults duveloped during the middle Miosene and earlier, as suggested by M.W. Rau. Smallar north-uest-te northmest-tranding right-lateral strite-slip faults show only minor displacement.

Pas thousand fooding is observed in the north-trending Satsop Synclims. Palbourne Anticlina and the Mynochea Anticline, which apparently are reactivations of older upifft. Broader mast-trending folde auch as the Still Creak Syncline raffect the older structural conjugate that pastdates Monteanno deposition compliments palacemegantic swidence for 15 degrees of slaterae retation found in 12 m.y.b.p. beaute in the Graya Harbor Basin af southmestarn Maghingtan.

# la Racific MM aubduction active decaying or incipient? The 2-m geoid

R C BOSTROM, U of Washington, Seettla, WA 98195 Evidence of subduction is sbundest is the pacific MW, but factaces Euch as a Meinese trough a does seisaloty are missing. We have used the 2-metac gold and confidentions of mantic of sealation on a guida to the states of the mundoution in the Pacific MW. The 2-m goold displays a distinctive alignatuse in section of the wester Associates where subduction is shown to be active. In 1999ass to hove become actinot, its goolds appears to hove become actinot, its goolds appears to hove become actinot, its goolds. AMALHOFF (ROS), S.C. (PGC), S.C. (FOC), S.C. (

aouth. At the latitude of the Ceilforniae, as N
Amazica has tasched the creat of the East
Pacific Riss aubdection has died out,
Cractai sxtension either has died out or has
'jamped' in the feshion described by Wood
1981; to a location such as the Gulf of
Ceilfornia within the continents margin. If
this diagnosis is cottact, subduction has been
active beheath Oragon & Washington, but is now
decaying. The Cacadas vuicasiam is in this
case the product of coavargence due principally
to the westward motion of W Amazica and the
hosting of estable proviously subducted. The
attucture of the northern boundory of the Basin
is Range province, dextrai shears or tenniforms,
auggate that as M Amazica approaches the Juan
do Fuce aegment of the East Pacific Riss, the
BR province will estand northwards into
Washington. The tiple junctions at Cape
Mendocine & Cabo Corsientes will continue to
move further apart, tracking the artisation of
Rudduction.

# Crustal Structure Beneath the Sapphire lectoric Block and the Idaho Batholith of Southwestern Miniana

G. J. CABLSON and S. D. SMIRIFF (Forthquate Persach

We used portable terminarables to record Pg Icrust) and Pn [montle] waves at 22 Lises from bletts in Anacond Mingrais Compeny's open pli mine in Butis, Montant. The recording vites the regularly distributed along a 280 km lind that relends northwest from Buile to near kilder, Idaho. We recorded blasts on severel deyt and fixed origin limes by using an array of permanent leismographs around Buile theil are operated by the Anatana Bureau of Hines and Geology. No bletts are a waitable near Wiltee that elfor reversel of this tolunter afraction prolife.

We recorded Pg strivais at all of the sites and Pn first arrivait at the world distint four sites. The Pg mave traveled at a spaparent velocity of 1.6 km/sec and the Pn nave trevels at an apparent velocity of 1.6 km/sec for an over simplified, two horizontal-layers model; these velocities and a Pn interept time of 6.9 sec suggest a depth to the Hoho of 35 km. This result is tongruent with the thithness of the trust near Buile, built is most lifely odd thin for the area near the loans bathofith. The Pn velocity is also too two for he area we investigated. If we use a more reasonable velocity of 8.0 km/sec for Pn than our date suggest that the Mono dips about 2.5° to the northwest along our refraction lian. Thus, thus thickness of the crust in creases from 35 km near Buile to soout 50 km magar Weilace.

This crusted thickness is somewhat gradiar than predicted for the sarea and shows that fartlary axtention has not cannot a seffective in thinning the crust in this part of Mongane as It has in the area immediataly southmast of Butta.

Interest point to the Note of 25 be. Interest to tonguent with the thithest of the trust near Bule, but it is most lifely to dish nor the area near the loads bathod this. The Previously is also too to for the area of meetingstar. If we are a more resumble to the crust increases from 35 km near Butle to another the country of the same and when 2.5° to the northest along our refraction liam. These, that thickness of the crust increases from 35 km near Butle to anout 50 km near Milace.

This crusted thickness is somethat guadar than predicted for the area and whose that facility arterion has not mean as effective in thinning the impedictation of the area of the same and whose that facility arterion has not mean as effective in thinning the impedictation of the same and whose that facility arterion has not mean as effective in thinning the impedictation of the same and whose that facility are impedicted for the same and whose that facility are impedicted for the same and whose that facility are impedicted for the same and whose that facility are impedicted for the same and whose that facility are impedicted for the same and whose that facility are impedicted for the same and whose that facility are impedicted for the same and whose that facility are impedicted for the same and whose that facility are impedicted for the same and whose that facility are impedicted for the same and whose that facility are impedicted for the same and whose that facility are impedicted for the same and whose that same and the same and the

# Co-operative systematic surveys over the northern Juan de Fuce Ridge system, 1901; a program theory.

MA]
D.M. HUBSCHG [Hawatt Imac, Geophysics, Honolato, H1)
J.t. Karsten (Univ. of Washington, Destric Wa)
A. HALAHOFT (ROS), S.P. RIDDIROUGH and O.A. SHEMANN

Usehington SEABEAN survey (rcm OSE BURVEYOE which completed detailed bathymatric reverage of the ridge up to its interasction with the Sevence 72. In July, a live-week suiti-parameter (gravity, magnetic and bathymatric) survey at 10 km spacing iscoulds PARIZEAU continued coverage out to 200 m. miles southwest of Vancauver faished. This covered the northern part of Junt de Fuca Sidge, the Sovence 72 and Explorer Ridge and was conducted by PGC in co-operation with the Canadian Hydrographic Service (ICS).

During August and Beptember two cruises concentrated on the northern coopenants of the spreading system—the Tuzo Wilson Incile, Delivoid Knolls and Explorer Ridge. There were a continuation of Stabean coverage by Mys from 058 URWKYOR and a Joint PARICKIS and Unity of Hawali cruites on My KAMA SEOKI using SEAMEC 11.

The condited data from these cruises provide a range of information from the regional to the detailed which will form the basis of a comprehensive acts of the Juan de Fuce Ridge system. It is planted that this will form the foundation for programs of detailed site and profiles invasingations and deep dives which are planted in 1904 and 1905.

#### An Analytical Method for the Ostereinstion of Gravity Terrain Corrections in Mountainous Tearain

Z. P. DANES | Department of Physics, University of Puget Sound, Tacona, VS 9841e; and Osses Research Associates, 4206 No. Lith, Tesons, VA 98406)

Improved and consistent values of terrain correc-tions can do obtained if the elevation range between the bottom of the tirer valleys and the tops of moun-tale posts is taken into account as if it were a layst of material of vattable density, gradually detreasing with height. The mothod is toegetatively feat, quito securate, and can he programed for a small peciet calculator, so that testain torrections can be deter-mined immediately to the field.

# Complete Bougust Granity Map of the Cascada Mountains,

The above map has been completed and published as a joint of the State of Meshlegton, Department of Natural Resources and the M. S. Department of Energy, it is divided into two sheats along the 479M parallel at a scale of 1:250,000, with a brown helf-tome background lopography. The contour interval is 5 mgal, surface reduction density 2.67 gcm<sup>-3</sup>.

For technical reasons, terrain corrections meth and south of the \$7th persital had to be calculated differently; as a consequence, there is a tare tenging from zero up to about 5 mgal between the two shoets. Greatly suluse all pelor volcants peaks about probably 00 recalculated with a autimoc density of about 2.3 gcm<sup>-2</sup>.

Analysis and interpretation of the various mouse lies are in progress.

#### A Georgeont C Depth-Sounding Profile Actors Quonn Charlotin Sound, Aritich Columbia, Canada JOH N. DELAURCER, L.K. LAW, D. AULD, Pacific Geosciante Centra, Box 6000, Sidney, 5.C. VOt 402

DUCING JULY and August 190), octan bottom magnatometers usin deployed at 3 since for a prollife extending stross the Queen Charlotte transform lawle mast the southern extremity of Queen Charlotte talends. Water Depths for those locations are 3010 m [aire 1], 2040 m [aire 2] Duting July and August 190), octan bottom magnetometer oatrenily of Queen Charlotte Intends. Water depths for these locations are 2010 a latte 11, 200 a latte 21, 1710 (size 3). A pagnetoceter was also installed at 1711 to (size 3). A pagnetoceter was also installed at 1711 to (size 3). As a pagnetoceter was also installed at 1711 to (size 3). But he in-phase and quedicular-phase patts of the geometric levertest to horizontal response at size 2 hove un-avocated in targa suplitudes to the size of the geometric latter of the size of the size and further department of the size of the s

# Relative Motions between Oceanic Plates of the Pacific Basin

D.C. EIGGEREISON | Department of Goology, Westarr Weshington University, Bailingham, MA 932251 A.V. COX | Department of Geophysics, Stanford University, Stanford, CA 943051 R.G. GOPDON | Department of Geological Scientas, Uorthwestarn University, Evansion, It 602013

In ly suggests that Liquerattlon generated the tebes; and was observed pended at the source of the RFL shortly after estimated by began and the peak of inher discharge on the swalenche sociales with spain at statement of the sale of the swalenche social des with spain at statement support the openies of the Only in this swall part of the avalenche were let blocks small adough to yended a large volume of intergrapher maitwater and esterate the swalenche deposite by the time saleste asheding hapen. An empirical swaltnessing addition in action to consistent with the conclusion that the saterian define could have thought on the ten saterian of other could have they inhere to disjoint more voluminous than say of the other inhere to disjoint more demagning because of its unusually long duracion and ensates the hay in cruption, and was commensurately more demagning because of its unusually long duracion and ensates pant discharge. Another unique sharmate static of the RFL was that it stated aoring down themsel at approximately 1510, 4.5 hours after both the sruption hagas

and after the other labare were intrinted. My results (odicate that the delayed initiation, long duration, and suntained peak discharge of the MTL can be directly related to correlative characteristies of the hermonic temor event. The hermonic tremor event, therefore, controlled the ability of the NTL to cause damagn.

Ividance for the late Econe Accretico of Peripheral Rothe of the Olympic Penionula, Vashioston

LER S. FAIRCHILD (Department of Geological Sciences, University of Washington, Smattle, WA 981951 JOHN H. APPENTROUT (Hobil Employation and Production Services, P.O. Sox 90D, Calles, TX 7522t1

Bervices, P.O. for 900, Calles, TX 7522tl

Buchan (low Pi ostamotiphism of the Lesch Rivet Conplex (LRC) of southern Vanconwer tailand anded 40 mys. Per 10 mys. The beauty plus of this type and age to worknown eleviders in western Washington and Vacrourer Salmon and suggests that the LRC was ellochthonous and empleted elter 40 mys. The beauty Crastest and Metchouse assisted elter 40 my. The beauty Crastest and Metchouse has attended the laceh elver fault (LRT), could not have been empleted until after the LRC along the Lesch elver fault (LRT), could not have been empleted until after the LRC along the Laceh elver fault (LRT) as strike-slip, and we propose that focome petiphetal rocks of the fitympics (including C-H) moved eastward during their accretion to weatern Vaningston, accessedated by at least 55 km of left-lateral motion on the LRT. Movement must have concluded hefore deposition of the late Oligocese Carannah Fen., which is not dispitated by the LRT.

This hypothesis pradicts large-masle, oast-west abortening south of the LRT after 40 my. The following evidence indicates that towerlative large-maghitude shortening occurred on proposed thrust (suits of the Olegovery Essy last system (RRT) on the eastern Olympic Paulmains (11 A profound sedicontery discontinuity mapped by Arrantrout [2] a sharp geomagnetic cytione indicates that the DRH to an extension of the Crascent Volcanics, (3) anomalous proximity of volcanic rocks of continuity and constrained suvceous on the DRT care late than "77 my, indicating the Econe peripheral rocks were esplaced between 40 and 37 myn.

Cowal, small Olippicaront on roverne faulis of the western Cacades and on the Davite Mountain lault ray have resplaced between 40 and 37 myn.

Cowal, small Olippicaront on roverne faulis of the western Cacades and on the Davite Mountain lault ray have resplaced between 40 and 37 myn.

#### Advanced Computer Graphics Applied to Geologic Problems of the Pacific Northwest

. P. FOOIE (Pacilic Northweat Laboratory, P.O. Ber 999, Richiend, Washington 99)52

G. N. PEIRIE (Pacific Northwest Laboratory, P.O. Box 999, Richland, Mashington 99152)

May of the stedios carried out ut Bettailo, Pacific horthwast toborocortos involve apatially dependent data sats that are large and complax. To obtain the maximum amount of information from these data sots at a reasonable lime, a eat of computer programs was developed to abstract, tombine, and diapity these large data sats. To litustrois this process, several data sats are presented. Included ore exemples from the Castada Momentains, the tolumble River Besin, Mt. St. Helans, the Olympic Mountains, and the Puget Lorlands. Each example Illustrators how tomputer graphic schonces the ability of the geologist to interpest and present complax date. In particular, adventiges of tombining diverse data sets into one three-dimentional image are presented.

#### Dating of Podelentifization to Pateuragneties S.L. 611324T (Longuitzert, 1711) - 2326d Ase. 51, Nood-Invitte, 88 990321

Invite, NA 99021

Ibdolonitiration, replacement of delonite by a calcular pseudosorph. In a serious weathering phenomena. Some ingerelated dedolocite is generally a companied by furnal ton a group on loss because delected on the contains a few mole person for the indeed, their or notions as the mole person for the indeed, their or notions as sell as channel considerations against the under obtaining conditions from the indeed of their conditions from the action the langue throat made obtaining conditions from the action the langue throat made in some item the langue throat made item from the langue throat made in some interpretation of the contact is sharp as it is able to the interpretation of the contact is sharp as it is able to the interpretation of the contact is sharp as it is a later than the transfers of a later than the contact is sharp as it is a later than the contact is sharp as it is a later than the contact is sharp as it is a later than the contact is sharp as it is a later than the contact is sharp as it is a later than the contact is sharp as it is a later than the contact is sharp as it is a later than the contact is sharp as it is a later than the contact is sharp as it is a later than the contact is sharp as it is a later than the contact is sharp as it is a later to the contact is sharp as it is a later to the contact is sharp as it is a sharp as the contact is a later to be indicated of later good later. In the Creat Basin literatores, a record time of dedolocitien of the both personal part of the preparation to a Noofe, but which in part is a preparation to confide a contact is a sharp as a personal and the preparation is a sharp as a personal and the preparation is a sharp of the preparation of the present day signal due to subligent form a sharp as a control of diagonetic personal pseudocitients and a source of diagonetic personal is a subject to a sharp as a control of diagonetic personal is a subject to a sharp as a control of diagonetic personal as a source of diagonetic personal as

#### Testopic Rotation and Besin Obvelopment Ouring pid-Tesetery Extension in the Pactfis Horibwest

The sarky-to-mid-Terttery sediusntary record in the Pacific Morchwast provides evidence that accretion of the Oragon Coast Range (OCE) was complete prior to too Coast Coast Range (OCE) was complete prior to too Coast Coast Range (OCE) was complete prior to too Coast Coast Range (OCE) was complete prior to the OCE overieps the notthern Standth Mountains. These scena subdit synchronous shanges in depositional style, intressity of deformation, classic composition, and sobsidence history, decomposition, and sobsidence history, decomposition that the OCE was accrated by c. 50 Ms., prior to deposition of the Tyes Fm. Resease the Tyes Fm to rotated meantly as much as the roleante basement on thich it rests, resailously arend.

The classic composition of the Tyes Fm strongly segment that its source area teached for beyond the Klassch Moentains and included parts of present day follow and sothessiare Newsia. These the OCE beain probably lys much forther to the east during Tyes probably by much farther to the east during Type deposition, and subsequently was rocated wastward to its pressuo position. Significant rotation, therefore, did not socus during collision of the OCR, but may bewe weet inicisted about 50 He and still conclaves. Mean

magnetic record, cas he accommodated by \*65% ascometos usthin the Corditiose.

Basis development occurred synchronous with extension, are algention, and tenconte rotation. Local and and unlift associated with exceptional and charmal tegional uplift messurement and manufactors and prograde greate the to reply deries sections and progresses for sease slong the consensors margin. To the ease, continuous suddancecton was mostly in gashes or puit-apart bashos. Sedimeotary basic development, Charafosa, una lacknessy sessortated with regional estaceido throughout the Pecific Mosthwest.

# Structure) and Porrogrammed Indicators for an Extensional Testonic Regime Imposed on Central High Concede Volcanism

S.S. Hughes (Rediation Center, Oregon State University, Corvellie, DR 97331] E.R. Taylor [Depártment of Goology, O.S.U., Corvellie] E.R. Taylor | Depártmant of Goology, O.S.U., Corval) | elShiale-building High Cascade Plotatosane-Holocona
meic levas arusted dum to crustal foundering and grabos subblidance (\*4.5 m.y. ego) miong an earlier undesitic Cascade crusta. Bannit (\*83 at.x 510.) and lessiic endesite (53-82 kt. x 510.) flow sequences inundeted
the depression to construct a mafic plutform upon which
calc-alkaline derivatives emerged. Intersecting northand northmat-freeding normal faults and vert eligncounts suggest an overlap of two tectomic regimes. The
normal-signed faults coincide with the everall High
Cascads trend of composite volcances whereas the serthwest-siligated faults represent a profrusion of the Brothere fault own into the High Cascade system.

Geochamical and pairtyraphic data indicate a penetic separation between Marsits and basalite Anderites.

\*\*Market Cascade\*\*
\*\*All Ca

Meetings (cont. on p. 330)

11 11 11

Meetings (runt. from p. 329)

ina basalis can be derived from volatila- and Lif mlammi-anriched upper mantla (35-45 kg) scerces whereas a lower trust (25-35 kg) scerce implied for basis tic andasilos. Plagfociaso phyric bessitic andasiles are progunsers to the silicle rele-athalina units via fractionation of pi-opatepaigt (PDAN) amarslogs, the basalis are not kypical of nerval calculations systems sithough they closely correspond to nutersional maric relectants by their predominantly diktytesilic finaline, higher TiO2, and a Ht-7a-Th tactonomagnalic discrimination which plause them out of the orogenic field. Structural and perfochanical relations agree with the sudden triesformation true Pilocene capitalise volcanic activity to Pieletocoms baselt dominance suggesting e deeper tourca implied within the calendard of a thornally-weakened crust.

# Paleotorirades, apparent displacements and internal sociations of the Sonanza Volcanics (Sorly Jurasair) of Vancouver [signd, S.C.

8. 189300 | Parific Geoscience Cantro, Box 600P.
55doev, S.C., VSt 5221
6. Sr 7028 (dept. of Goslogy, Carfason University,
Ossaws, Osi., R15 526|

Tateomagnetic chaerys; ions from 14 stiss in she
Bosans Voltanics at mosthern Vencourss islead have
yislded a poluciant tude of 21° 2 5°. There is en
subligative at owhether that is north or south.
Assuming their it is 21°8 then comparison with the
Zarly Jurusian reference itself for unration;
Sarth Assertica places Vancouver Island in the lastitude
of California with an encapisant of about 19°. This
youlates is not significantly different free the
Exemutate voltables; i.e. Vencouver telend undazvant
ilette or no notion reletive so North Aberira during
the Late Wifseic and Early Jureasio. The motions are
more uceping if the south helitudinal option is
assumed. The overprint we observed Storn the Karmutann laiand sequired to bring it late lao prosent position is post-mid frainceous. The simplost seylanation of paleomagnetic date from Tancouver Island thorshors is that the Island was strusted in the Latitude of and moved narrhward in the present position in post-sid traincrans tips. Different social than in the 90° are observed at different local thus in the Bonants and providu sayls evidence of very large post-Early Juranale roles loos. These may have occurred by arc-banding once after Sometion, during cottleion with the mid-Kenusoir continents eargin of Sarrh America, or during the norshward movement.

# Strike-slip-faulf control(1) on the geometry and origin of the Ecceme Chuckmruf basin, northwast Usakington

# Strain Accomplation to Vaneguvar Island and Vashington H. LISCHSFI (USCS, Medic Park, CA 24UZ1 estimpt, af Couphysics and Autonomy, Univ. of Brilish Colonbie, Yancourer, B.C. Vot 1U11 M.- S.LMIN | Hepst. of Couphysics and Associate, Univ. of Brilish (alumbic, Venecurer, B.C. Vot [U1]

The measured principal strain raice (is universitated and bishing of the exis of manifest cooperation across full detail on networks motivated by the U.S. Feelogital

Survey in its Stairie, Reacord, and Olympis farts, Washington areas are at follows:

Setwers Fruch C; C, 0 Segrity 1977-01 -0.010.01 -0.1219.07 RenSord 17ff-01 -0.0210.01 -0.0217.01 0 7"127" 0tympir 1997-03 0.2110.33 -0.2370.15 K47"0213" The second deviator is printipal attain rates in prad/s) and bearing of the arm of maxima compression arrass triangularion private measured by the Geodotic Survey of Canda in the Johnstone Strait and in west-central Vancouver legand are as follows:

Rerwork Epoch Ki ri Johnstone Straft 1914-66 0.03:0.01 -0.03:0.01 H 5\*W170\* Gold Siver 1917-82 0.13:0.06 -0.13:0.05 N39\*5:f0\* Extension is taken as positive and uncertainties are standard derim tonu. The area of maximus templession are generally close to the 850°S direction of convergence between the Juan du Fure and North American glafes. Catom of atrain accumulation generally agest with those cateulared from a dapph officialion model with the shallow portion of the mutduclica some

#### Magna Subly and Resdigatesat of the Territor System of Et. Selens during 1930

S. PALCEE

5. ECARDCAS [Geophysion, Frog., Untr. of Vanb.,
Sealtie, VA 95195 Sermacent Advers: Georvatorio Yesuviano, 80058 Ereolano, 17217]

A sequence of five explosion empions efacting with the Mar 18 curnolymnic occupring losh place over the samer and fait of 1980 et Apunt St. Prisons. The return of explosion products from each of these sreptions decreased uniformly one this period, end the therefor of most empion progressed from a fairtly continuous empion heating more than eight hours on May 18 to earness of ecorr lurger agreed 12 hours apart on Coroner 16. elor lurge apared 15 bors apart on Oofbar 15-18. Each empilion was fottowed by an affershock-liks series of sarthquites. Those cartiquizes were distributed at deplica belwan 7 and 17 ha surround-lang an earthquake from some of "20 ha". The satesic dorray released during each of these arun-firm sequences is proportioned to its corresponding

Vs propose a modef in anich eagas is supplied from a repurpole? to it to deep at a colform rote controller again by its viatestly. It rious inrough a marrow rowself to a shill we one where disruption can take place and the o supta to the surface as the same or at a higher role in explosing burnie. The deep estate to a resilucturant and volume decrease to the deep runarrots. The transition is the character of these crupitan assurants from one protonged aruption on May 18, to technical protonged aruption on May 18, to technical protonged aruption on May 18, to technical country the bursts in Octuber can be suplated by a difference to the magnet aupply rate to the diaruption score. Ve storose a molef in affich eages in supplied

# Harrhnoriboes Source Found for Mid losens Subsec Fan Deposir on Indian and Harrowstone Islands, Harrhwest Machington

L. A. Helin (Wasners Mashington University, Bellingham, Machington) [Sponsors C. A. Suczek]

The menamed Entern unit well amposed on the beaches of Indian and Parrowstons Islands to Sorthwast Washington consists of shick to way thirk bedded sadstone with minor shalls inverteds. There are also at least two 20 re 30 meser thick shell beds.

Measive. Pish siructures, poorly developed parallol lamination, loed tests and shale rip-ap clasts are focally shandami. Amalgenation of several Inich sandatone hede large very ribth (3-5 ml beds is tormore although edgen difficult to recognize due to the measive esters of the hede. The state hede are measive or lesiested with reractively grippic arosa-siralification. Several pagesoniasporaneous siumpa are present. The section along the east comet of indian island was measured and described in detail revealing at least aleven thinning and Ching upward esquence. Unscenent fute rearr indicate a source to the sorthnorthwest. The unit was deposited as themselfill sequences on the mid-far region of a subsection. The two thick shelp hede were deposited on inactive regions of the fan between active themself.

Punctuated Volcaniers in Osegon's Comet Mange

Expression R. HCLIMER and A.-e. District denses in Country Organics. Organics of the Country, Covality, op 97:311

How a-Ar age determinations performed on uplor Eccene banklive rocks of the Oregon and Machington Foast Pargo help to constain factonic models of fair origin. Three optimides of late Eccess to dispectes volcanians have been recognized to the 41 my, 37 in 31 my, and 10 for 27 my. The earliest relivity spanned a period troe of 10 my and produced the upper Tillacook Volcanics of scattering the color of the same of the Country of t

#### Mid Tayl lary Ristory of the Oregon Western Concades ogy, Univ. of Gragou, Eugene, OR 07403

Fossiliferous Middle Terriary marine rocks of the Gregon Western Cascadas hand themselves particularly east for interpostarion of the local and regional geolugir history. Teclenit Instability to the Eccembility to the Eccembility to the Eccembility to the Eccembility and Interval here to reflected by shrugt sea level thougan, spul influe of volcanight eaterlat, increased grouten and high sedimentation rates.

By utilizing pelocasymalic date, other workers have only recently generated a new model for Pasific Marthwest records history. The latter model appeals to an sifebificous arigin for what is now the Gregon Comes Anne and Willameria Belief.

Lo for tourse of our work on the geology of the Wantern Cascadas we have identified easyful appearsof irragularities to the total faunal distributions, sydfmarprology rad physiosymphy. Most of thems sometime may be explained that adopt the sea tocked easy. Fossillferous Middle farriary marine rocks of the

# tectanic Evolution of the Southern Margin of the Stagit Crystelline Core of the North Cascadas N. B. Killat (Bept, Geology, Clerk College, Yencowar, Mr. 98663) |Spansor: P. Misth]

Obduction, regional meteorphism, and plutonism occurred at the southern surgin of its Shadit trystalline tone during a brief interval in the mid-crataceous. The Windy Fass intrust [WT] servied tho taste Arasic ingalis ophiolitu methand anto the paiftle Chimaukan Schist of the Stagit tone. Above the WT, the ingalis is imbrituated with metascellenuts and orthografisms. Thericajion coincided with amphibolite-facies wetworphism of the upper plafais 95 m.y. U-Pb age (N. Happe, pers. rows.) of a sonalific orthografism probably dates retemorphism and lebrication.

The lover-pinta Chimautum Schiat experienced 3 phases of folding and both Berrovian- and Buchantype amphibolite-facias metascephism in the Cretaceous; tight to isocilms F2 folds dominate. Numerous eliramátic pods were faulted into the Chimautum prior to F2. Bioritic alias, prasmably precursors of the 39-96 m.y. Big Jim phase of the At. Stuart Batholith (HSS), were intruded late during F2. F2 folds and allis were finitened during explacement of the Big Jim phase. The main phase (BB-93 m.y) of the MSB trunch as the WT end cludy and the plates, induction and metamorphism of the upper plate probably colocided with folding and matamorphism of the Lineautum, and may have overlapped intrusion of the Big Jim phase. Flowerer films amplicacement of the Chimatum, and may have overlapped intrusion of the Big Jim phase. Flower overlapped intrusion of the Big Jim phase.

# Evolution of the erstern Cosst Moyotelns, near 1911 oper aguthwastern British Columbia

J.W.H. MOYGER (Geological Survey of Canada, Yenzouver, B.C., Y68 [76] P. YAN DER HEYDEN P. YAN DER RETUEN
J.F. MASIAND [both nf: Geological Sciences, University
of British Columbia, Yancouver, B.C. YST 284)
[Sponcer: M.E. Bark]

Caris in the eastern margin of the Cost Mouofains, southwast of Lillicost, are malely veriable deformed and celeorybosed that, srgillits, bath volcanits, minor terbonsis and all rangics of its Middle Triessic who resemptions chart, signifite, basic volcanes, whose reposts and allianatics of its Middle Triesle to lower Jurasaic Bridge Ricer Complex (800; C.J., Potter, 1981), lower Cretereous Recording and older (f) tissics of the Brew Group [86], and feto Cretage-ous and Juriary granitir infrusions. Reconsulassance capping and preliminary isologic daling suggest the following evolution: (ii post-vosrcism (-175 Maj disruption of 88C, toylcally producing charter "brolam ferration"; (2) post-Reconden [-125 Maj fight to identify 10 of 88C forming in playsa Large-state (lat-jung loids with Sanhest-dipping alail surfaces, and [7] recorded deformation in 1985; (3) infrusion and conset surfacephise of deformed 86 by granitic rorfs that aserby yield 60-70 Ma K-Ar 1981; (4) eastword brittle overfheebing of 89C on 86 and atrusions, possibly concomitantly with sub-horizontal detries sharing, inotinal folding and metamorphism fo bigitte garref grads of lower-least 88C. Concoment symplificad in livitions in the letter yield strooms with 49 Ma U-Pb 34 bb-bb ages; [1] jurisposifion of all unifs by high-sigle tauts that splay northeststy of the nosth-holf Fresor tauf tone. Fissign track date:

[8.8, Parrish, 1982] Indicate major spliff prior to 39 Ma.

Since these rocks its [80 km north of insteads and

# 3) Na. Since these rocks its 180 km north of intitede 490 on the rest side of the Fresct-Sirsight Creek deared feels system, their evolution may been on their of the higher matemorphic grade rocks in the core of the Northsyn Castedes.

Patriofogfo Evolution of the Lafe Cretaceous Manaigo Meeta: British Columbia and Mashington PACUT, J.A. | Geological Research Group | ARCU Oll End Gas Co. Delice Texas 7528f]

The Late Crategious Hanslag Besin Formed Wilhie, en oroganio collage, surrounded by the Rorth Cactadee, Coetal Plutonio Belt, Insular

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Cascodes and boeld roluenic rook fragments and whort from the hauler Belt. As the basin evolvod, input from these sources decreased and saddmentation into the basin was domineted by pfutonir debria from the Cosarsi Plutoniu Holt, with subordinars deposition of plutoniu and infaresediars—to silicit—volueniu debris trom the lesuisr Belt.

Dominance of plutonic ouer volceniu debris dorived from the Cosatul Plutoniu Bait supprets desp disanction. Contemporaneous volueniu rouk fragments ers conceitouously absent. A magmetic pap oudurrad in the southern Cosarsi Plutonic Batt during Nansiae Basin deselopment and the rectoniu esting is cheracterized by a broad sono ot right-lateral tronsucurrant taulting. These derr suppset that subduction may hees greatly stowed or useed elem the uentimentul margin of Oritish Cojumbis ducing the Late Cretaceous.

The Respect of the subducted Juan de Fuca

POSIN SIGDIWOUGH (Pacific Geometerce Confrs. P.O. Box 6000, Sidney, B.g. Canada V&t 482

There is good directatelential, and some researchic interactial, reidence ther the rubducting Juan do Fuer piete can be divided then a shellow dipping 1410°) apper section and a misopar dipping (39-40°) towar section. This pieces is in common with mong audducted slabs which show some form of discontinuous

subducted slobs which show sace form of discontinuous geometry as they descent into the nantia. A number of explinations for such secontry have been advenced, these vages troy the believes of accretion the leading adja of the overlying plate re discrete awards to the history of convergence such as climpos is absolute valently or the students of easiemic vidges. Nose of these apparentions seems to be antirely settlefactory for the Juen de Fun pirts. This suggests that it may be a continuous dynamic promise introduced a combination of depth related promise changes, towersence raren and the age of the subducting lichesphere.

Queen Charlotte-Pairweather Transform Kay

ROBLE STROTROSCH, CARRY ROCKES and Sitt YSILE, ICACLIFIC temperature Combin, Box 800P, Sidner, S.C. 781 4821

The region of transfers interaction between the Pacific and America places from the Aleutian trench re the Juan de Your Ridge Fricle junction and the edjacest attakes areas of the torth-basi Pacific Genes are between in the adjacest attakes areas of the torth-basi Pacific Genes are between in the authority of leasessing gaourismitti Infasest.

Foftewing the success of the Juan de Pura place cap, we congues to produce a similar map for this ragion. A sausdetype impograph fr/hathymeist base out at a state of f.2,000,000 has been prepared. Its corness area of 72,000,000 has been prepared. Its corness area of 72,000,000 has been prepared. Its corness area of 72,000,000 has been prepared. Its corness area of 74,000,000 has been prepared. The projection is Lambert Conferent Conic chosen so their is with evertey the Juan de Pura Map in the gooth.

the acult.

He invirs comments, adrice and support no eft separts of the eap and the project.

Struttural influence on Party Terriary Sedimaniary Seafn Goosetry, Southwestern Bergon

FYSTES, PAUL T. |Laboratory of Contestouffs, Department of Genericuss, Salverates of Arizona, Tuccon, AZ 83721) |Epomeors P. L. Heller)

E111583

Belt and Sen Juon Island terrases. It may hove dausloped on a pull-apart basin within a proto-Gusen Chariotts transform zone or as an letramasait forearc basin.

Paleocurrant ond patrographiu date indiusts that during sarly davalepment of the basin, it was filled isrgoly with dabols rith in chert and subordinate argilleucous and intermediate-voluanty rock fragments from Sen Juan laiand terranes, intermediate-voluanic and low-grade between the fragments from the North Cascodes and boeiu reluanic rock fragments and whort from the Inquier Selt. As the basin avolved, input from these sources decreeed that although these lastice were no longer settles at the class of Type deposition, their relief setil toffic-enced the distribution of sediment closs the souther margin of the basis, a miner secont of secrenc reaion may have bren accomplated by these early Second Caulia, but at lunch 50° of clustulas rotarion must faulle, but at them to the transfer of the transfer have accurred after deposition of the Type Saranifer Prorein paleomagnetic data are insufficient to distinguish differential tectanic rotations on either side

# Revised Siretigraphy of the Deschutes basin, Gregon: Implications for the Neogane Development of the rentral Gregon Castades

GARY A. SMITH LAWRENCE W. SMEE (Both of: Dept. of Ceology, Oregon State Univ., Corvellis, OR 97331)

Voltanic and opiciastic material of the Gerhates for (OF) was derived from anneatral High Cascrde voltance which subsided into an axial grabes about 4.5 m.y.b.p. and were buried under youngor volcooles. A mid Hiscare base for the OF was based on fossils and a 18.28.30 b.y.c. Ar dais on the Poltan baself mother (cacac. from Armairong af al., 1975). A new "Our 1984 date of 7.6 (3.3 m.y. (ia) on the Poltan baself is considered to be a more arrurals age for this low-F, waper-differentleated?), unit which immediately under lies Late Hiscare focalls. An angular unconformity apparates the Pelcon baself from the underlying rorks, bearing mid-Hiscare focalis. An angular unconformity separates the Pelcon baself from the underlying rorks, bearing mid-Hiscare focalis. now assigned to the Statustus formalion [ST] which over lice, and is interbedded with, the Orbetta River Baself Group (CRIIG). The OF voltanic episode thus represents only the period 7.5-4.5 m.y.b.p. when a large volume of pyrocinstic material and issa bit crupied in the contral Oregon Cascades, in response to regional lension that culminated to the formation of the graben. Preservation of the Cascades volcanic record in adjacent man-marine basies is not respect. Deposition of ST was a result of appreciation cound by disruption of Calumbia basis undanage by the CRSC. Df aggradation was a response to expendincy pyrecistic aggradation was a response to extraordinary procisit voltanism in a seni-orid of male and preservation was arsared by overlying, lorgely intrabelin-derived, ira flows. The approx. 6 m.y. hintus in Deschutes bein stratigraphy does not represent Cascade quiescent, but rather improper conditions for processalin in the record. \*(Ref: isochran/Hast, #13, p. 5-19)

# Proposition as a Machenism of Ridge Reprintation in the Just de Pura Area

NEIGLAS A. WILING (Gasphyairn Bapt., Stanfesd Gairs, Stroford, CA 94303)
SCHARD S. SY | Strippe teerfution of Gesfragraphy,
La Jaffa, Paisforeir \$2993)
CLYDE S. WISETHUAN | Dapt. of Geologist | Stisects,
Stown Salversist, Providence, Rhode below Priit)

We pressor a revised model of festosic evolution of the June de Yuta sidge by propagating ritting. The man model has these different relativa relating. The man model has these different relativa relation poles, everying the rise inference in 7.8-5.5 a.y., it.5-5.9 w.y., and 3.9 w.y. to the present. The retarine pole biftle at 8.5 and 5.9 w.y. trift relation pole biftle at 8.5 and 5.9 w.y. trift of 19 to 13. As neth of those shifter, the patrons of propagation reorganisms, and the new ridget torned by propagation rear at so or learning a test by orthogonal for the new direction of antice about the orthogonal for the new direction of antice about the orthogonal for the new direction of antice about the orthogonal for the pre-existing ridges. The soft propagation expenses the result of the second continuity and the propagation against the second for the second propagation against about annual test of the second for the second We present a revised model of Fastonic evaluation of

#### The Selenograph Setwork in Sritish Columbia - 1983 Coloranguetic evidence for 36° unitolockylps retailed of northorn Filesadre Laland - possible her to solution of the Hares Struit problem

La 1983 forty delemograph affarious are huing operated in Stitlab Columbia by three different agentical the Earth Yngaire Stanch at the Yarific Footflower Centro (C.C.C.), the Department of Ecophysics and Astronomy at the Galversity of Stitlah Columbia 18.5.-1 and the British Columbia Hydro and Comus Amiberity [S.C.H.). These include three international standard at a component stations, review alongly component where pariod similars and State telemograph design on the State of State o F. J. WYRNE, S. INVING [Cacilic Onsectores Centra,

Box 6000, Sidney, R.C., V&L 482)

K. OSADETZ | leastfure of Sedimentary and fatrology

Geology, 3393 - 33 Sr. S.W., Calgary, Alir., 772 247)

Coolegy, 1393 - 13 Sr. a.W., Calgary, Airc., 711 287

Osolegy, 1393 - 13 Sr. a.W., Calgary, Airc., 711 287

The seriy Curminn Sasyon Forention | basefary Sastemann | from two |
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AZ 33721) [Eponsors P. L. Hellar]

The geneity of sedimentary basics that developed during early turstary rise to southwestern Oregan was controlled by synthenoses deformation. Several majes foult system were arrive unril 45 myby, lorinding the Sonance, selarl, Powers-Bosse, and Smyonvitta faults. There ismits displace sedimentary tacks of seriy borcase tenurical age, and are overtapped by middlu Eocase (Smills also) sediments. The Sonance Fault mar Aurisella, is a morthwest-verging reverse/fract fault with an issual tion of the serig Econes Enaburg Forthatton the between enters in stars which branch off the main fault mear Eocasing. The Saferi Fault, south of Rosseburg, trends mosthesetward with a stary linear trace. Locally apposed sirrleded surfaces, and displanud lacies suggest 5-5 hm of sight-lateral artise-sity appearation. The Socration and construction of the safe porth-south freeding reverse last, acceptable to the seaters block him been uplifted at a linest 1000 m. Chapteed Masospir threat contrait, and offest early Socrat sediments of 10 km of freeding Cabyone | 10 km; treeding Cabyone | 10 km; treeding Cabyone | 10 km; treeding Cabyone | 10 km; apprairies. En Valocities and Station Delays in Machington C. ZENVAS R. CROSSON | both at Geophysics Prog. | Univ. of Wesh., Sectile, VA 981951

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the upper restie voicelty of the region and the ruleive utoclon delays due to the variability of crutal structure in the region. Comparison of prelicinary results for the souturn we. Now seaton side of the Cascade Range indiustes a serked change in valually trum d.3 km/sec asst of the Cascades to 7.5 km/sec west of the Cascades. This resear is consistent with previous studius but represents a more significant result becomes of the substantially increased date and due to both more stations and a larger number of syunts. Analysis of azimurchal silecty and veriolines within subrappions is previously suggested refructure models and to taprove our knowlodge of the deep cruet and upper

# Geophysical Year

A date at the end of all entry indicates the issue of Ess in which a full meeting authounteness was

A list of abbreviations used in the Geophysical Year calendar appears at the end of the calendar.

#### Future AGU Meetloge:

Fall Meetings

Dec. 3-7, 1984, San Francisco (Abitracts dur mid-September 1984) Dec. 9-13, 1985, San Francisco (Abstracts due mid-September 1985)

Spring Meetings May 14-17, 1984, Cincianeti May 27-S1, 1985, Rahimocc Abstracts dur early Alarch 1985

Chopmon Conferences The Magnetospheric Polar Cap August 6–9, 1984, Fairbanks (Aluterts dur May 1, 1984) Vertical Crustal Motion: Measucement and Modeling October 22–26, 1984, Harpers Ferry, W. Va. (Ablinets dur August 1, 1984)

#### 1984

28 April 24–26 Fourth Annual Front Range Branch Hydrology Daya, Fort Collins, Colo. JH. J. Morel-Seytoux, Dept. of Civil Engineering, Colorado State Univ., Fort Collins, Ct1 80523; tel. 303–491-5448 or 8549.) JNov. 22, 1948.

1983.1 April 24-27 Pacific Confecence on Marine Technology (PACON 84), Honolulu, Hawaii. Sponsors, Macine Technology Society, AGU. 1PACON 84, Center for Engineering Re-statch, Univ. of Flawaii at Manoa, Honolulu, H1 96822, etc. 808-948-7358 or 7-149.1 (Aug. 16, 1983.)

16, 1983.) April 26-27 Sixth Annual Texas A&M Granly April 20-27 Sixth Annual Texas A&M Gendynamics Research Program Symporium on Collidon Tectonical Deformation of Confinental Lithosphere, Hollege Station, Tex. Spunsors, Inter-Union Commission on the Lithosphere, NASA, and the Commission on Malline Geophysics of IAPSO, (Texas A&M Geodynamics Office, College Station, TX 77843-3114; rel. 409-845-8477.)

April 29-May 4 Penrose Conference on Processes and Products of Muhitspace Melting and

Ceues and Products of Multistage Melting and Metasometism in the Manile, Cold Canyon Ranch, Ariz. Sponsors, GSA and USGS. (J. E. Pike, USGS, 345 Michilefield Rd., MS 75, Alenio Park, CA 94025.) [Oct. 25, 1985.)
April 30-May 3 International Association for Great Lakes Research Annual Confecence, St. Catherines, Ontario, Camada. IJ. Teresmae, Dept. Geological Science, Brock Univ., St. Catherines, Omario L23 3A J. Canada; (cl.: 415-688-5550.)

April 30-May 3 50th Annual Technical Mecining Environmental Integration Technology Today for a Quality Tomorrow, Orlando, Fla. Sponsor, Institute of Environmental Sciences. Unstitute for Environmental Sciences, 940 E. Northwest Hwy., Muuni Prospect, 11, 80056; tel.: 312-255-1501.)

April 30-Alay 4 Pentruse Conference on Structural Styles and Deformational Fabrics of Accretionary Complexes, Enceka/Attata, Lalif. Sponsor, GSA. (Vestern Experience, 24511 Central Ave., Suite P-2, Hurihler, CC) 80303; tel. 309.449-3352.]

tel. 303-449-3352.)

May-lune 12th International Congess on Irrigation and Drainage, Furr Collins, Colo.

(ICID, 48 Nyayn Marg, Chamkyapuri, New Delhi 110012, India.)

May 7-9 Third Symposium on Aretle Air Chemistry, Downsview, Ontario, Canada. (L. A. Barrie, Armospheric Environment Service, 4905 Dufferin St., Downsview, Ontario M3H 574, Canada, tel. 418-667-4785; or K. A. Rahn, Graduate School of Oceanography, Univ. of Rhode Island, Norraganaett, R1 02882-1197, sel.: 401-792-6251.) (Aug. 23, May 14-18. Canada, Val. 24, May 14-18. Canada)

May 14-18 Geological Assoc. of Conacia and Mineralogical Assoc. of Conacia Joint Annual Meeting. London, Ontario, Canada. (N. U. Meetern Ontario, London, Ontario N6A 5B7, Canada.) May 14-17 AGU Spring Meeting, Cincinnati, Ohio, (Meetings, AGU, 2000) Florida Ave., N.39. Washington, DC 20009.

Ohio. (Mectings, AGU, 2000 Florida Ave., N.W. Washington, DC 20009.)

Msy 20-23 U. S. SPOT 8ymposium, Scottsdale, Arlz. Sponsor, SPOT IMAGE Corporation. (Nadine Binger, SPOT IMAGE Corporation, 1150 17th 3treet NW, Suhe 307, Washington, DC 20036; tel.: 202-293-1886.) (April 10, 1984.)

May 20-25 International Symposium on Deep Observation and Sampling of the Continental Gruss Through Drilling, Torrytown, N. Y. (Barry Raleigh, Director, Lamont-Doherty Geological Observatory, Palisades, NY 10964; 151. 914-359-2900.)

May 21-23 International Groundwater Symposium on Groundwater Resources Utilization and Contaminant Hydrogeology, Montreal, Canada. Sponsors, Canadian National Chapter of the International Association of Hydrogeologists and the Canadian Water Well Association. (A. Kohul, Chairman, International Croundwater Symposium Montreal '84, Ministry of the Environment, 765 Broughton St., Victoria, B. C., VSV IXS, Canada.)

Msy 21-29 Symposium on Climatel History, Periodichy, and Predictability, NY. (John E. Sanders, Dept. of Geology, Barnard College; Columbia Univ. New York, NY. 10017; tel.: 212-280, 4312.) (Aug. 23, 1983.)

Modificadon, Park City, Utah. Sponsor, American Meteorological Society, (Edward Hadman, Dept., Almospherie Science, Colorado State Univ., Ft. Collins, CO 80525; tel. 343-25. Fourth National Symposium and

Exposition on Aquifer Restoration and Groundwater Monitoring, Columbus, Chio. Sponsor, National Water Well Association. (N'WWA, 500 W. Wilson Bridge Rd., Wor-thington, OH 43085; tel.: 614-846-9355.1 May 23-25 Workshop on Precipitation En-hancement, Park City. Utah. Sponsors, Na-tional Science Eugalatics and American

May 20—25 Workshop on Precipitation Enhancement, Park City, Utah, Sponsors, National Science Foundation and American Meteorological Society, 1Roscoe Braham, Dept. of Geophysical Sciences, Univ. of Chicago, Chicago, 11, 60037; rel. 312-962-8123/8124.)

May 24—26 Symposium on the Hlatory of Soll and Water Consessordon, Colombia, Mo. Sponsors, Missouri Collural Heritage Center at the Univ. of Missouri, the Agricultural History Society, and the Soil Conservation Service of the U.S. Dept. of Agriculture. (Susan Flader, Dept. of History, Univ. of Missouri, Columbia, MO 652 [1, tel.: 514-882-248] or 314-42-1058; or Douglas Helms, Historian, Soil Conservation Service, P.O. Box 2800, Washington, DC 20013, tel.: 202-382-0042.)

May 28—June 9 12th International Congress on Irrigotion and Drainage, Fort Collins, Colo. Sponsors, U.S. Committee on Irrigation, Drainage, and Flood Cantrol (UCIDFC), AGU. (UCIDFC, P.O. Box 15326, Denver, CO 802 [5,1]

AGU. (UCIDFC, P.O. Box 15326, Denver, CO 80215.)
May 29-31 Urban Water '84—A Time For Reocwal, Baltimote, Md. Sponsor, American Society of Civil Engineers Water Resouttes Planning and Management Division. (Harold Day, College of Environmental Science, Univ. of Wisconsin at Green 8ay, Green 8ny, WI 54301; tel. 414-405-2250.)
May 29-lane I foint Meeting of the 11th Appli-

54301; tel. 414-40S-2250.)

May 29-June 1 Joint Meeting of the 11th Annual Meeting of the Canadlan Geophysical

Union and the 18th Annual Congress of the
Canadlan Meteotological and Oceanographic
Society, Halifax, Nova 5500ia. Canadla. (S. D.
Smith or H. 8. Jacksun, Bedford Institute of
Occanography, P.O. Box 1008, Darrmouth,
Nova Scotia, Canada B2Y 4A2.1 (Aug. 30,
1983.)

1983.)
June 4-6 International Conference on Inverse
Publents of Acountic and Elesde Waves, Jihsca, N. V. Sponsor, Council University, (YihHsing Pao, Department of Theoretical and
Applied Mechanics, Cornell University, Ithaca, NY 14853; tel.: 807-256-23-15.) June 47 Symposium on Climate and Paleoclimate
of Lakes, Rivers, and Gleelers, Igh, Austria.
Sponsor, International Commission on Cliof Lakes, Rivers, and Gloclers, Igls, Austria. Sponsor, International Commission on Climete, IAMAP. (M. Kulm, Institut für Metenrologie und Geophysik, 5choepfsttesse 41, A-6020 Innsbruck, Austria.) (Oct. 25, 1985.) June 4–8 IWRA Seminar on River Besin Strategy, Linköping, Sweden. (U. Lohm, Water Theme, Linköping Unic., S-58183, Linköping, Sweden.) (Oct. 18, 1985.) June 4–8 Serrenth International Conference on Almospheric Electricity, Albany, N. Y. 5ponsors, IAMAP International Commission on Almospheric Electricity, AMS, and AGU. (R.

Amospheric Electricity, Abarty, N., 2 sponsors, IAMAP International Commission on Annuspheric Electricity, AMS, and AGU, (R. E. Orville, Atmospheric Electricity Conference, E.S. 214, 1400 Washington Ave, SUNV, Albany, NV 12222; tel.: 518-157-3:87.) (July 26, 1983.)

June 4-8 Third International Conference on Urban Storm Drylinge, Gotebory, Sweden, Sponsors, IAHR and International Association on Water Pullution Research, (P. Malmqciat, 20) (tept. of Hydranlics, Ilhalmert Univ. of Technology, S-1)2-96 timelary, Sweden, June 15-9 Second American Lonference on Ice Nucleating Beeterla, Flagstaff, Adz. (Ralph 31, Bilby Research Lenter, Oox 6013, Northern Arizona Univ., Flagstaff, Adz. (Ralph 15, 1983.)

June 10-15 Gilli Annual Meeting of the American Association for the Advancement of Science (Pacific Division), San I rangento, Calif. (John 11, Vann, Ocp., of Ucegraphy,

American Association for the Advancement of Science (Pacific Division), Sait Lampan, Calif. (John II. Vaint, Dept. of Geography, Galifornia State Univ., Hayward, CA 94542; tel.; 415-881-5193.) (Jan. 31, 1984.) June 11-12. Fifth Entopean Confecence on Environmental Pollution, Amsterdam, The Netherlands, IV. M. Bhatnager, Bux 1779, Cornwall, Ontario K6H 577, Canada.) June 11-13. Synipotinin on Critical Assessment of Forecastlag in Western Water Resoucce Management, Scattle, Wash. Sponsors, AWRA and AGU. 1G. R. Aliuton, President, Resoutce Planting Assoc., 113 Lynn St., Seattle, WA 98109; tel.: 208-282-1681.) (June 28, 1985.) June 17-23. Second International Tamanti Conference, Las Vegas, Nev., Cfsunami Society, Rnx 8523, Honolidu, H1 96815.)
June 18-22. Fifth International Conference on Finite Elementa in Water Resoucces, Burlington, V1. Sponsors, Univ. of Vermont, AGU. (J. P. Laible, Dept. of Civil Engineering and Mechenical Engineering, Univ. of Vermont, Burlington, V7 05405; tel.: 802-056-3800.1
June 19-21. Third International Conference on Marine Simulation, Rouerdam, The Netherlands. [Secretarial MARSIM 84, 60 Alaridam Research Institute Netherlands, P.O. 80x 1555, 3000 BN Rotterdam, The Netherlands.

80x 1555, 3000 BN Rollerdam, The Neuter-lands.)
June 25-50 Penrose Conference on McIsnges of the Appalachlan Orogen, Newfoundland, Canada. Sponsor, GSA. (Brenna E. Lorenz, Dept. of Earth Sciences, Memoriel Univ. of Newfoundland, Sr. Johns, Newfoundland A18 3X5 Canada.) (June 28, 1983.)
June 24 International Conference on Geo-mombrenes, Denver. Colo. (A. I. Johnson, Woodward-Clyde Consultants, 7600 E. Or-chard Rd., Englewood, CO 80111; tel.: 303-094-2770.1

Woodward-Clyde Consultants, 7000 L. Orchard Rd., Englewood, CO 80111; tel.: 303-094-2770.1

June 24 International Sympositum on Imparmeable Barriers for Soil and Rock, Denver, Golo. (A. I. Johnson, Woodward-Clyde Consultants, 7600 E. Orchard Rd., Englewood, CO 80111; tel.: 303-694-2770.)

Jime 24-50 [41]. International Conference on Mathematical Geophysics, Loen, Norway, (L. Tronrud, NTNF/NORSAR, P.O. 80x 61, N. 2007 Kjeller, Norway; telex: 18147 kcin.)

June 25-27 Rock Mechanics in Protection and Productivity, 25th U.S. Symposium on Rock Mechanics, Evanston, Ill. Sponsor, AGU. (Charles H. Dowding, Dopt. of Civil Engineering, Northwestern Univ., Evanston, Ill. 00201; tel.: 312-492-7270.) (Sept. 18, 1983.)

June 25-July 7 ICSU Committee on Space Research 25th Mecting, Graz, Austria. (Rithard C. Hart, Space Science 80ard, 1H-828; National Academy of Sciences, 2101 Consulution Ave., N. W., Washington, DC 20418.)

June 26-28 Symposium of Bace Observations for Cilmale 8tudies, Graz, Austria. Sponsor, World Climate Program, (S. Ruiteoberg, Secretary, COSPAR Commission A, NCAR, 8oulder, CO 80307.) (Inly 19, 1983.)

June 28-28 Symposium of the Achievements of the International Magnetosphorie 8tudy, Graz, Austria. Sponsor, ICSU Scientific Committee on Solar-Terretrial Physics. (J. G. Roederer, Geophysical Justifule, Univ. of Alaska, Fatrhanka, AK 99701.)

June 28-28 1984 International Conference on Lightning and Static Electricity, Orlando, Ina. 8ponsors, NOAA, IEEE, 3A E-AE4 Committee, and reveral military and divillan air, Israportation agencies in the U.S. and UK. (J. J. Fither, Conference Chairman, U.S. Naval Air Systems Command, P.O. 80x, 15038, Arlington, VA 22218; tel.: 202-692-7822; or

**表。《中心》**《数字》

G. Otlani, European Coordinator, Royal Aircraft Establishment, Fainborough, Hants, GUL-5TD UK; tel.: 0252-24461, ent. 2638.1

GU1-1 5TD UK; rel.: 0252-24461, ent. 2638.1 18ept. 6, 1983)
June 2i-28 International Symposium on Deep Structure of the Coatlaental Cruati Results from Reflection Seismanlage, thaca, N.Y. Spansors, Fornell University Institute for the Study of the Continents, AGU, GSA, IASPEI, International Lithosphere Program, SEG. (Muawia Rarazangi, Conference Coordinator, Dept. of Geological Stiences, Cornell Univ., Ithata, NY 14853; rel.: 607-256-6411 ur telex; 937478.]

July 2-5 Symposium on the Physics of the Megnetosphero-tonosphere Connection, Graz, Austria, Spunsor, L'ammittee on Space Research of ICSU. (E. R. Schnerling, E.E.-8, NASA Headquarters, Washington, DC 20540.) (Dec. 6, 1983.)

20540.) (Dec. 6, 1985.)
July 5-6 Securi Symposium on Plasma Doable Layers and Relaied Toples, Innshrurk, Austria. (R. Schrillwieser, Inst. for Theoretical Physics, Univ. of Innshruck, Sillgave 8, A-6020 Innsbruck, Austria.)
July 9-15 International Symposium on Space Techniques for Geodynamics, Sopron. Flungaria. Academy of Sciences and IAG/COSPAR Joint Commission on the International Coordination of Space Techniques for Geodew. and Gendynamics. Techniques for Geordes; and Gendynamics. (Ch. Reigher, Deutsches Geoldsicher Forschungsinstitut, Abs. 1, Marstallplatz 8, D-8000 Munich 22, FRG.1

Munich 22. FRG.1
July 9-13 Longitude Zero, Greenwich, UK.
Sponsors, International Union for the History
and Philosophy of Science and the International Astronomical Union. (Conference Offitet, "Longitude Zero" Symposium, National
Maritime Museum, Greenwich, London 5EO
9NF, UK.) (Nov. 15, 1983.)
July 10-14 The Case for Mars 11, Boulder,
Coln. Sponsor, Mars Institute of the Planetary
Society. (Flelen Hart, Laboratory for Amusspheric and Space Physics, Univ. of Colorado,
Boulder, CO 803109; tel.: 303-492-8822; Carrol
5toker or Tom Meyer, Case for Mass, P.O.
Rox 4877, Boulder, L'O 80305; tel.: 303-1948144.1 (Dec. 20, 1983.)

500ker or Tom Meyer, Case for Mass, P.O.
Rox 4877, Bonhler, I.O. 80305; tel.: 303-1948144.1 (Dec. 20, 1983.4
July 18-20 Selsmle Deconvolution Workshop,
Vail, Colo. Spousor, S.E.G. (Seen Treitel,
Amoco Production Co., Research Center, P.D.
Box 591, Tuba, OK 74102.) (Feb. 7, 1984.)
July 19-25 Symposium on Wave Breaking,
Turbulent Mixing, and Radio Probing of the
Ocean Surface, Semilai, Japan. 10, M. Phillips,
Dept. of Farth and Planetary Sciences, Johns
Hopkins Univ., Baltimore, MD 21218; tel.:
301-338-7036.)
July 21-28 Eighth World Conference on
Earthquake Englaceriog, San Francisco, Calif.
Sponsor, Earthquake Engineering Research
Inatinue (EER1), AGU. 1]. Penzien. Cheir8WCEE, EER1, 2620 Telegraph Ave., Berleley, CA 94701.)
July 23-25 Summer Computer Simulation
Conference, Boston, Mast. Sponsor, Society
for Computer Simulation. (W. D. Wale, 1984
SCSC. Program Lhaitman, Wade Engineering
P.C., P.O. Box 849, Huntington, NY 11743;
tel.: 516-471-6073.4
July 21-20 Hith International Symposium on
Urben Hydrology, Haltanlies, and Sediment
Lontrol, Leangban, Ky, Sponsor, Univ. of
Krimicky, Jr. Anden, Complianor, Taffice of
Continuing Education/Engineering, 223
Transportation Research Bilg., Univ. of Kenmekt, Lexington, KY 40596-0043; tel.: 606257-3972.1 (Nov. 15, 1983.)
July 24-26 Water Rights Specialty Conference, Hogstaff, Auis, Sponsors, Ground Water

July 24-26 (MW. 15, 1983.)

July 24-26 Water Rights Specialty Conference, Flagstaff, Axis, Sponsors, Ground Water Foundation and Value Water Foundation of the ANCE Irrigation and Drawage Division, (Keineth G. Renard, Southweit Watersheit

(Kenneth C. Kenard, Southwest Watersheel Research Center, 2000 E. Allen Rd., Theson, AZ 85719; tel: 602-429-0581.) Juli 26-27 A Joint Workshop of the Commin-tee on Cilmatic Changes and the Ocean and the Joint Stlenific Committee for World Cil-mate Resister Panel, Sendai, Japan. (O. M. Phillipt, Dept. Earth and Planetary Sciences, Johns Hopkins Univ., Baltimore, MD 21218; vel.: 301-538-7036.)

johns Hophins Unite, Ballimore, RD 51216;
ed.: 301-338-71356.

July 30-August 2 Seminer on Water Management Practice, Zecia, Nigeria, Sponsora, International Association for Hydraulic Research and UNE5CO. (Gunnar Lindh, Dept. of Water Resourcea Engineering, Lund Insditute of Technology, Fast. 725, S-220 07 Lund, Sweden.) (Dec. 6, 1983.)

July 30-August 5 Eurogeophysics Assembly, Louvain-fa-Neuve, Belgium, Sponsor, European Geophysical Society, G. M. 8 rown, Dept. of Physics, Univ. College of Wales, Aberystwyth, Wales, UK), [Dec. 20, 1983.)

July 31-Aug. 2 Fourth International Symposium on Stochaade Hydraufies, Univ. of Illinois, Urbana-Champaign, Sponsors, LAHR and AGU. (8en C. Yen, Wilson H. Tang, or Glenn E. Stout, Dept. of Civil Eng., Univ. of Illinois, 208 N. Romine St., Urbana, II. 61801; tel.: 217-553-0687 or 333-0536.] (Nov. 8, 1983.)

July 31-August 3 Workshop on Fission Track Dadng, Troy, N. Y. Sportsors, General Elec-tric R&D Lab., SUNY at Albany, and Rensse-leer Polytechnic Institute. (Donald S. Miller, Dept of Geology, Rensselaer Polytechnic Insti-tute, Troy, NY 12181.)

Aug. 4-14 27th Ioternational Geological Congress, Moscow, USSR Sponsors, USSR National Committee for Geology, IUGS. (Organizing Committee of the 27th IGC, Institute of the Lithophece, 22, Staromonetry, Moscow, 109180, USSR.) Aug. 6-9 Chapman Conference on the Magne-

tophecle Polar Cap., Fairbanks, Alaska. (Pokar Cap Meeting, AGU, 2000 Florida Ave., N.W., Washington, DC 20009). (Jan. 24, 1984.). Aug. 12–16 20th Annual AWRA Cooference and Symposium, Washington, D. C. (Ariene Didiz, U.S. Army Corps of Engineers, Institute for Water Resmirces, Casey 8idg., Fort Belvoir, VA 22060; tel.: 703-855-2368.) (Aug. 10, 1983.)

Aug. 13-17 12th International Laser Radar Conference, Aix-en-Provence, France. Spon-sors, IAMAP and AM3. (G. Megie or J. P. Granler, Sersice D'Aéronomie du GNRS, 12th International Laser Radar Conference, BP 3, 91370-Vernères le Buisson, France.) (Nov. 8,

1985.)
Aug. 14-17 Specialty Conference on Water for Resource Development; Coeur d'Alene, Itlaho, Sponsor, Hydraulics Division of ASCE. (Hirry Tuvel, American Society of Civil Engineets, 345 E. 47th 31. New York, NY 10017-2398; led.: 212-705-7494.)
Aug. 21-29 International Radiation Symposium 84 (IRS), Perugia, Italy, Sponsor, IA-MAP Radiation Commission. (Glorgio Fiosco, Chairman, IRS '84, Dipartimento di Fisica, Città Universitaria, 00185 Rôme, Italy; scless: 1NFNRO 613256.)
Aug. 22-28 Field Conference on Open System Behavior in Magmadic Evolutions Petrological, Geochemical, and Geophysical Constitutions, Taos, N. Mex. Sponsor, Insidute for the Study of Earth and Man. (Mike Dungon, Dept. of Geological Sciences, Southern Meth-

odísi University, Dallas, TX 75275; tel.: 214-692-2750.1 (Jan. 17, 1984.)
Aug. 26-29 Geothormal Resources Council 1984 Annual Mecting, Reno, Nev. (Geothermal Resources Council, P.O. Box 1350, Davia, CA 95617; tel.: 916-75R-2560.1 [Feb. 7, 1984.]
Aug. 26-31 Seventh Anatrallan Geological Convention, Sydney, Australia, Sponsor, Geological Society of Australia. (Secretary 7 AGC, P.O. Box 383, North Ryde, NSIV, Australia 2115.) 1Nov. 931, 1985.1

P.O. Box 383, North Ryde, NSW, Australia 2113.) [Nov. 29, 1983.]

Aug. 27–31 Seventh LAHR Symposium on lec, Hamburg, Germany. (J. Schwarz, ice Engineering Div., Hamburgische Schiffbau-Versuchanstali GnibH., P.O. Bon 600 929, 2000 Hamburg, FRG.) (Nov. 22, 1983.]

Aug. 27–Sepi. 6 General Assembly of URSI, Florence, Italy. (Vito Cappellini, 1ROE, Via Panclatchil 64, 50127 Firenze, Italy.) (Dec. 27, 1983.]

1983.]
Sept. 3-7 Quadecturial Ozone Symposlum,
Halkieliki, Greece. Sponsors, IAMAP International Ozone Commission (IOC), Commission
of the European Communities, the Academy
of Athens, and WMO. (Christos S. Zerofos,
Chairman, Local Organising Committee,

of Alhens, and WMO. (Christos S. Zerofos, Chairman, Local Organuing Committee, Physics Dept., Campus Box 148, Uair. of Thesaslorikl, Thessaloaiki, Greece. Send copy of infurmation request to C. D. Walshaw, Secretary, IOC, Clarendon Laboratory, Oxfand Univ., Parks Rd., Oxford, OXI 3PU, UK.) Sept. 10–12 Oceano 84 Confetence and Exhibition, Washington, D. C. Sponsors, Marine Diny, Paris Rd., Oxford, OXI 3PO, UK.)

5ept. 10–12 Oceano 84 Conference and Exhibition, Washington, D. C. Sponsors, Marine Technology Society, AGU, and Institute of Electrical and Electronics Engineers/Oceanit Engineering Society. [Oceans 84 Technical Program Committee, 1730 M St. N.W., Suite 412, Washington, DC 20036.] (Now. 29, 1983.)

5ept. 10–14 International Symposium on Hydromechaolcal Balances of Fresh Woter Systems, Stockholm/Uppsala, Sweden. Sponsors, Swedish Natusal Science Research Council, UNESCO, and IAHS. [M. Falkenmark, Exec. Sec. NFRS, Comm. for Hydrology, Box 6711, 5-11385 Sinckholm, Sweden.)

5ept. 12–14 5cminar on Degratation, Retention, and Dispersion of Pollutaalo ia Groundwater, Cupenlugen, Denmark, Sponsor, Internalional Association on Wates Pollution Research and Control. (Erik Arvin, Dept. of Encironmental Engineering, Building 115C, Technical Univ. of Denmark, 10K-2800

Lyngley, Hennark. (Oce. 13, 1983.)

Technical Univ. of Denmark, DK-2800 Lynghy, Bennark. (Dec. 13, 1983.) Sept. 21—24 International Symposium on Eavironmeal Pollution, Site Th Be Announced. IV. M. Bhatnager, Box 1779, Cornwall, Omarin Kijl 3V7, Canada.) Sept. 24—25 Seminar: Enhanced Binlogical Removal of Phosphorus From Wasteweter, Paris, France, Sponsor, International Assoriation on Water Pulluting Research and Control. (Michel Flocentz, Physologyus Seminar. tion on Water Pollitifini Research and Control, (Alikhel Flocentz, Phosphorus Seminar, Anjou-Recherche, 52, Rue d'Anjou, 7/384 Paris Ceden 08, France; Tel.; 266–91–56; telex: Geneaux 280 332 F.4 (Sept. 6, 1983.) Sept. 24–26 International Water Well Exposition, Las Vegas, Nev. Spansur, National Water Well Association, (National Water Well Association, 500 W. Wilson Bridge Rd., Worthington, OH 4/0/85; tel.; 614–84(6/4356.) Sept. 24–28 SLEAHS (Salt Cakes, Evaporites, Acolian Deposits) Workshop on Cenozole Salt Laken and Arld Zone Hydrology, Geocleutisty, Stratigraphy, and Paleotenvironments. Mathoura, New South Wales, Australia, Sponsing, the Australian Nanonal Latheesity (L. M.

ity, Stadigraphy, and Paleo-environments. Mathoura, New South Wales, Australia. Spotsur, the Australian Nanonal Liniversity. J. M. Bowler, Irop., of Biogeography and Germorphology, Recarch School of Parine Studies, Australian National University, GPC Box J. Camberra 2001, Australia. J (March 27, 1984.) Sept., 25–28. Seventh National Groundwaler Challity Symposium, Las Vegas, Nev Spotsot, National Walth Well Association. INWWA, 2011 W. Wilson Bridge Rd., Worthington, OH 43045; tel.: 614-846-955. J Oct. 1–5. International Symposium on Recent Investigations in the Zone of Aeration, Munich, FRG. Sponsot, Technical Univ. of Munich, 1P. Udlait, R1ZA Symposium, Institut for Wasterehemic det TU Minchen, Matchioninist. 17, 10-8000 Munich 70, FRG.) (Dec. 20, 1983.)

nich. 19. Olibili, RIAA Synipositiii, Institut für Wasterelemie de TU Milinchen, Matchioninist. 17, 19-8000 Munich 70, FRG.) (Dec. 20, 1933.)

Ot. 1–6 European Seismological Commission, Mosrow. (Organizing Committee, ESC. Soviet Geophysical Committee, Moloderhaq a 3, 117 296 Moscow. USSR.)

Ot. 3–5 Symposium on Meteorology and Oceanography of Northern High Latitudes, Anchorage, Alaska. Sponsors, American Meteotological Society and AAAS. (Stuari Bigler, National Weather Service, 701 C. St., P.O. Box 23, Anthorage, AK 99513.) [March 8, 1984.]

Ot. 8–11 World Gooference on Remota Sensiog, Bnyreuth, FRG. Sponsoss, Univ. of Bayreuth, Texas Christian Univ. Center for Remote Sensing and Energy Research, and International Society of Toxicological and Environmental Chemista. [Leo W. Newlaud, Director, Environment Sciences Program, Texas Christian Univ., Fort Worth, TX 76129; tel.: 817-921-7271.) (Feb. 7, 1984.)

Oct. 10–12 Seismological Society of America Eastern Socilon 58th Annual Meeting, St. Louis, Mo. (Robert B. Herrmann, Dept. of Earth and Atmospherle Sciences, St. Louis Univ., P.O. Box 8099, St. Louis, MO 63156; tel.:514-658-5120.)

Oct. 10–13 New Mexico Geological Society 35th Annual Field Confecence, Taos, N. Mex. (R. Riecker, General Chaisman, Los Alamos National Laboratory, Mail Stop D446, Earth and Space Sciences Div., Los Alamos, NM 87845.) (Nov. 1, 1983.)

Oct. 16–19 International Symposium on Lako and Watershed Management Local Involvement, Malfec, N. 1, 3 ponsor, North American Lake Management Society. (Harry Gibbons, Jr., Dept. of Civil and Environmental Engineering, Washington, Science, 1944-2912.) [Mauch 8, 1984.).]

Oct. 17–19 A1PG Annual Meeting, Oriando, Fia. 1Bobby J. Timmons, General Chafman, Timmons Associates, P.O. Boa 50006, Jacksonville, Fi. 3250; tel.: 904-24488.]

Oct. 30–Nov. 3 Symposium on Relationships Between Climate of China and Global Cilimate—Past, Present, and Putture, Peking, China. Sponsors, Academis Sinica, International Association of Meteorology and Almospheric Physics, Academi

na.) (March 27, 1984.)
Oct. 81-Nov. 7 Reglettal Assembly of IA.

SPEI, Hyderabad, India. (Mohan L. Gupta,
Organizing Committee, IASPEI Regional Assembly, National Geophysical Research Institue, Hyderabad-500 007, India; telez; 155478 NGRI IN; cable: Geophysics.) (Aug. 28,
1988.)

Nov. Mexican Geophysical Union Annual Meeting, La Pas, Baja California Sur, Mexico.

Meetings (cont. on p. 332) 1 2 2 13

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#### Meetings (cout. from p. 331)

tUnion Geofisica Mexicana, A.C., Comite Oc-ganizador Reumon (981, Apartado Postal 1805, Fuvenada 22800, B.C.N. Mesico.)

1809, Five natic 22800, B.C.N. Mesico, Nov. 5-8 GSA Annual Meeting, Reno. Nev. (Jean Laudippe, GSA, P.C. Box 9140, Bond-der, CA 80301; ed.: 303-447-2020.] Nov. 12-17 Water for South Africa, Johannes-burg, South Africa, Spontagra, National Water Well Association and the Burefulk Water As-

Well Association and the Barreliole Water Association of Southern Africa. (Ossid M. Nicleen, Conference Coordinator, NWWA, 500 W. Wilson Heigles Rd., Worthington, OH 43083; tel.: (i)4-846-8458.) (Dec. 3-7 AGU Fall Meetling, San Francisco. (Meetings, AGU, 2000 Florida Asc., N.W., Washington, HC 20009)

Dec. 16-21 International Chemical Congress of Patific Basin Societies, Homidulu, Hattail, Sponsors, ACS, Chemical Institute of Canarla, and Chemical Society of Japan. (PAG CHEM 84, Meetings and Divisional Activities Dept., ACS, 1155 16th St., N.W., Wathington, DC 2003(ct.). 202-872-4896; PAC CHEM 84, Chemical Institute of Canarla, 151 Slates St., Solte 900, Ottawa, Ottario K IP 5H3, Canada; tel.: (i)3-235-5023; PAC CHEM 84, Chemical Society of Japan, 1-5, Kanda-Surrigadai, Chiquda-ko, Tokyo 101, Japan; tel.: 03-292-6H01-15ept. 13, 1983.)

Des. 28-31 Foorth International Conference on Applied Numerical Modeling, Tainats, Taiwan, CS. Y. Wang, School of Engineering, Under di Mississippi, University, MS 38677; tel.: 601-232-72 [9.]

#### 1985

Jan. 7-12. 17th International Congrets on Hydrogeology of Rocks of Low Permeability, Tincson, Ariz. Sponsora, International Astrodation of Hydrogeologists, AGU, (E. S. Simpson, Dent. of Hydrodogy and Water Resources, College of Engineering, Unit. of Arizma, Tincson, AZ 85721.)

March 10-15. American Society of Photogram-

March 10-15 American Society of Photogram-metry and American Congress on SurveyIng and Mapping National Meeting, WathIngton, D. C. (Willard, A. Kimeis, 44-15 Jensen Ph., Farlax, VA 22032; tel.: 703-425-8780.) April 1-4 European Union of Geossiences Bi-emidal Meeting, Strasboneg, France, (Grganiz-ing Committee, Hept. of Facult Sciences, Univ. of Cambridge, Downing St., Cambridge CB2 3EO, UK.1

St. Cambridge, Friwning St., Cambridge Can St. Q. UK. 1 22 April 9–11 Fifth Annual Front Range Branch Hydrology Days, Fort Collins, Colo. (H. J. Morel-Sertoux, Dept. of Civil Engineering, Colorado State Puly, Furt Collins, CO 80523; tel.: 303-491-54-18 or 8549.)

Cali. 303-491-34-18 or 8549.)
May 27-31 AGU Spriog Meeting, Bakimore, Mrd. (Meetings, AGU, 2000 Florida Ave., N.W., Washington, 16: 20008.)
Summer (Zollospinian on Compacation Study of Magnetospheric Systems, Frame, Bombrique Le Quém and Bent Modler-Polersen, 17A-SCIP, Cherrystoire de Membrin, F 92195, Meudon Prin pal Cedex, France; Telex: 200-590 CNE f CBS.) (Aug. 9, 1983.)
June 3-15 TWRA Filth World Congress On Water Recourses, Brussels International Conference Centre, Parc des Expositions, Tentoonstellingspark, B-1020 Haussels, Belgium; rel.: 32-2-47h-48-60; telex: 23-643.) (Aug. 30, 1983.)

52-2478-478-60; teles: 23-645.) [Aug. 30, 1983.]
June 16-21. Third International Symposium on Analysis of Seismicity and Seismic Risk, Liblice, Czechoslovakia. [Z. Schenkova, Geophysical Institute, Bocni II, 14151 Prague 4, Czechoslovakia.]

physical Institute, puch 11, 14131 (1980) a. Czechoslovakia, june 26-28 U.S. Symposlum on Rock Mechaelca, Rapid City, 5. Dak. Sponsor, South Dakota School of Mines and Technology. (Eileen Athworth, Chairman, 26th U.S. Symposium on Rock Mechaelcs, Dept. of Mining Eastern School of Mining Eastern

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Mentenhall. 126 South Oval Mall. Columbus.
OH 43210.]
Aug. 19-30 23rd General Assembly of IASPEI, Tokyo, Japan. Ryotuke Sato, Syretary-General of the 23rd General Assembly of
IASPEI, to linter Group Corp., Akasaka Yamakatsu Bldg., 8-5-32, Akasaka, Minato-ku,
Tokyo 107, Japan; tel.: Tokyo 103) 479-5311.)
Sept. 16-21 Symposia on Potasale Volcanism
and Etna Volcano, Catania, Italy. Sponsor.
IAVCEI. (G. Frazzette and G. Lanasfame, Iytituto Internazionale di Vulcanologia, V.le R.
Margherlia, 6, Catania, Italy.) (Dec. 27, 1983.)
Sept. 17-21 AIPG Assoul Meeting, St. Paul,
Minn. (Robert E. Prendergast, General Chairman, Geotechnical Engineering Corp., 1925
Oakcrest Ave., Roseville, MN 55113; tel.: 612636-7744.)
Oct. 14-17 GSA Annual Meeting, Boston,
Mass. (Jeon Latolippe, GSA, P.O. Bos 91-10,
Bnulder, CO 80301; tel.: 303-447-2020.)
Dec. 9-13 AGU Fall Meetleg, San Frenvisco.
(Meeting, AGU, 2000 Florida Ave., N.W.,
Washington, DC 20009.]

June, 1986 Conference on Study and Mitiga-tion of Hazards, Sen Martin. Sponsor, Tauna-mi Sigirty. (Hazards Conference, Box 60536, Las Vegas, NV 89160.)

AAAS American Association for the Advancement

AAPG American Association of Petroleum Geolo-

gistr
ACS American Chemical Society
AIPC American Institute of Professional Geologists
AMS American Meteosological Society
ASCE American Society of Civil Engineers
AVRA American Water Resources Association

AWRA American Water negotives assumed in GSA Geological Society of America IAG International Association of Geodesy IAGA International Association of Geomagnetism

nnd Aeronomy

IAHR International Association for Hydraulic Re-

rearch IAHS International Association of Hydrological Sci-

IAMAP International Association of Melcorology

eralogista
URSI (nternational Union of Radio Science
WMO World Meteorological Organization

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SIMULTANEOUS SIDATOSPHERIC MEASUREMENTS OF Had NO., AND CH., FROM BALLON-BORNE AND AIRCRAFT INFRANES SOMA MASCARTION SECTRA AND TUMABLE OLOGE LASER LABORATORY SPECTRA OF HOD C. P. Rinsland (MASA langley Research Cantar, Mall Slop 401A, Mamplon, N. 23665) A. Boldman, V. Halathy Davi, B. Fridoviyh, O. G. Murcray, M. A. (Sonith, B. R. Seels, Jr., M. T. Coffay, and M. G. Meacle High rasolution infrared acist absorption apactes recorded from a belicon-borne platform at 13 km allitude and an aircraft at 12 km allitude have been analysed to derive simplianaous sicalospharly toncevertalese of ago, MDO, and Ch., The dais sery oblained rear 37<sup>th</sup> with the University of Denver Interferomoter during a belicon-filgh in October 1978 and with the MCAR interfarameter aboard a Sabralind Piccraft in Santeeber 1982. The analysis of the belicon spectra indicatar the M2O mixing resid invrassed from 1.5 to 4.8 ppms and the Ch. mixing ratio decreased from 1.5 to 0.70 ppow between 18 to 38 km. Tumeble diode laser isboratory apparirs nece reported and analysized to derive absolute intensities and air-broadened half widths of selected lives of the wabond of MOO. With these premoters, which are reported here, an MOO profilm which increases from 10.6 ppm near 18 km to 0.88 ppbs near 28 km interfer view of 118 slowle partip remitties of 51 andere Man Oyeam Maler (SMOM), of 0.55 to 0.67. The irrane Of 118 slowle partip remitties of 51 andere Man Oyeam Maler (SMOM), of 0.55 to 0.67. The irrane Of 118 slowle partip remitties of 51 andere Man Oyeam Maler (SMOM), of 0.55 to 0.67. The irrane Of 10 and show 12 km darling spectra of 118 slowle partip remitties of 118 stone of 118 sl IAMAP International Association of Meteorology and Atmospheric Physics
IAPSO feternational Association for the Physical Sciences of the Ocean
IASPEL International Association of Sciencology and Physics of the Earth's Interior
IAVGEI International Association of Volcanology and Chemistry of the Earth's Interior
ICSU International Council of Scientific Unions
IUGG International Union of Geodery and Geoplusies
IUGS International Union of Geological Sciences
IWBA International Water Resources Association
MSA Mineralogical Society of America
SEG Society of Exploration Geophysicists
SEPM Society of Economis Peleontologists and Mineralogical Society of Economis Peleontologists and Mineralogical Sciences

O700 Scattering

REPARTIES TERRORES AN ASSEMBLY OF AMISOTROPIC RECTAINS TERRORES AN ASSEMBLY OF AMISOTROPIC RECTAINS AND MAGNETIC CIPOLS SCATTERED

J. S. Remonit (Dept. of Bisectrians I Regissering, Manush Witwenity, Clayton Sidd, Australia)

The propagation of electromagnetic naves through a random ensembly of sleatric end magnetic dipols scatcarers is considered. The results may be taken as the leading team of the solution for more general malicipols scat-terdas. Helilple forward scattering and the cobernot wave approach of J. S. Emilus ese comparad. To the Yest order, the theories differ andly in list they predict different wame poheniselism. Particular extension is given to the case is which the distribution of coetener or contentations is axingumental. It is found that the walte the distribution of costiceor oriuntalism is axisymmetris. It is found than this case can be treated as procagation shrough on assembly of uniformly situated equivalent exacterss. The applications of the remains to propagation through raio is discussed briefly. (Olpole scatteress, random messably).

Oddo Magnetic and winstrical methods CONTINUTION OF POTENTIAL PIGLON DETWEEN ARBITHARS

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Red. Sci., Paper 480555

### **Exploration Geophysics** Cido Tides, Wares and Winls CAT IN 70 Blans" "COMMENTS ON "YOTENTIAL" TAXATPENT

A theosetical opecial model is groweded to describe the mean (somely everaged) circulation and laiteding in the resperature and composition. The results show that solar differential healthy by radiation at low lettendes and Joseph dissipations. nearing by radial on at too latitudes and Joule digsi-pation at auroral latitudes are orientily responsible for the objected temperature and density agriculture. One to every advection by the mean medicional aircu-lation, the (latitudinal) vertations in the cateal pressure fiel? are relatively small, but eignificant inspersions and composition pressure analogal med through wind induced diffusion. In the dissipative andius of the upper therosphere, pressure gradients ore not very sifective in dytains the seam circulaand on the upper thereasphere, pressure stadions one not very affective in driving the seen circulation; has the contribution to superrotation is negligible. At low sed and latitudes, the integes ansation to the correlations between the borizontal und finite of the diurnal tide and the diurnal tide and the diurnal tide and the diurnal tide, and to a lesses extent the correlations extend the correlations extend the correlations astend the correlations extend the diurnal tide, student a transfer and pressure gradients of the diurnal tide, student a transfer and pressure after the analysis of 200 to 100 to "patential" for the valuatity divergence squittom used paralously by Sinauli and Niver Se unti-thissed, while the "potential" for the pressure variable becomes singular whesever the greeify-wave frequency equals the local headproved Spuni Proquenty.

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#### Electromagnetics

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gas cands have been dellind and found production.

However, the sands are leavest and affahore to the sands. In the Gardon Banks area of offshore Louisions several gas cands have been deliled and found productive. However, the sands are laterally variable in photests and effectiveness. In suprawed understanding of the spatial distribution to net producible gas send in highly desirable for reservoir maneadment. The hrighly reflections from the top and the base of sects and were trached automatically on an interactive interpretales mytion. This highly desirable for reservoir manea for sects and were trached automatically on an interactive interpretales mytion. This yielfad time attructure maps and bases it offers maps for each grows and interval, for horizon Saincrop<sup>TM</sup> anctions displaying amplicudes were the sed interfaces were thousemend, adjusted for tuning elfasts, and good help to yield settimate of net gas/gross tuit ratio uver the cross under tindy. By combining these with the corresponding tinchron maps and an exprepricta gas and interval velocity, we obtained not gat test implication maps which the acceptably with well fats, integration of these provided total reservoir velocity.

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0910 Salanic methods OIP-MOVEGUT BY POURIPE TRANSPORK Baye Hale (Chevron Oil Fleid &conserch Company, P.S. let AA6, La Eshra, CA FOSIII

New Asia (Chevron Oil Field assessed Company, P.S. set AAA, La Bahra, CA 708111

The case actions in ormal moveout 14x01 cat common-sulpoint (COM) thacking process ashesces reflections having a particular moveout velocity, whits attenuating events ituch as muticiple reflections fished different moveout velocities. Unfortunetally, this pracessing acts as a dip filter applied to the SRP state. In other words, NOO and staching enhances reflections having a partirular sloop in the GOP stach, while alternating reflections having different alopse. BOO sood stacting like may Pip filter, deprende laters translation.

Yortunately, this dip-filtering action can in suppressed by applying, in addition to MMO, a greatest process known variously as OBO LISH, prestact partial suggresses with difference as he latter term imples, this process is a dip-dependent general testure term imples, this process is a dip-dependent general testure termington. this process is a dip-dapandant moveaut correction this enables reflections from both horizontal and diplar relicators to De stacked with the same XMP velocities attends another way, NNO velocities estimate? from dip-moveout-corrected melamograms are independent dips of subsurface reflectors.

dlp-movaout-carracted seismograms are incapasant at the dips of anhauriance reflectors.

Olp-moveout by Fouriac transform to a mathal far parlorming Fip-movenut (ONO t torrection is the iraquency-mayenumber domain. The jupismentation of effecting method, which resembles the (upismentation of a flecting flowers) with previously published limited-difference for all official flowers with previously published limited-difference for all notificial and the diplet of the difference for a finited-difference, is accurate for all official and the diplet, provided that velocity is reported. Except to limit fut the application of both by Fourier transfere to recorded telemograms demuntaries the ability of sills processe to onhance filthe dip benduich of FMF state thad 121 the necurecy of velocity estimates.

OPOPHYRICI, Tol., 44, MO. 4

OSIG Selemic methods
TWO-Poliar SAY TRACING IN A THEFS-PINEGRICHAL HEBUT
CONSISTING OF ROMOTHROOD MONISOTROPIC LATFES STRALATED
ST PLANT INTERFACES
R. F. diothil 17.F.P., dopt. of Neumedonsis y Aigr.
Geoficies, Awdn. Fra. 8.8. Form Iff-df. 1993, 1355 Select
Alces, G. Argancinal
The rev-leading problem is considered the solution to
minimum travel lims problem for ossis where such Lyrr
may be reparted as a transversely leartopic benegation
solid. The wave surface-wavefront at S = 1 s.
corresponding to a wave squaretad or 1 be point tearre,
namociated with each imper's emisotropy is appresimated
by surfaces which are not more difficult to heaft. Fra
a computational point of view, than allipsoid: twifath.
These approximation is shue obtained.

DEOPHYSICS, VOL. 45, NJ. d

0914 Reiseld wethors axiamic vissance contact see tof powegoist F-wave DOWNGOIRD F-Neve J. J. Selles (Deophysics) Corvice Inc., F.G. No. 113971, MR 1904, Ralles, TR 112051 Me 1900, Relies, Th 11205)

While the need for phose compensation to will established, the heat meshed to espure the salast vibroier output is not. These coulrel of the force souted by designed vibrator upon the earth's series especially described to the salast to present consistent downhole freeze which compere the deviable results are presented which compere the deviable contribution competed by the salast organishment. results are presented which compare the deviall correlation wavelets produced by physiciothing to great lorce! reaction means acceleration and heipfair acceleration as changes in vibrocor type, temperature and the physicial results appear on the complex continuous are used. The compirical results support estilar theoractes with which profices with unliable essentials theoractes with the profices with unliable essent loss that great force and fer-field particle displacement are impating except for a time delay.

GEOPHYSIYA, VOL. 43, NO. 6

0930 Selemic meshede toward con FULL MAYETRALF ACCURATE L. J. Hoher 18tance Production Sessarsh Company, y.O. 512 [185] Boutton, TX 118011

fig; bouton, TR 110011

Most sheoratias studies of scoustic hershols legics
have amployed the shaple model of fiuld hershols is as
have amployed the shaple model of fiuld hershols for the
infolice solid. This work attempts to account for the
laweded some value a mass sophisticated most theil
additionally interested the second to theil CONTINIER OF FOTRILAL FIELDS BETWEEN ABBITRARY

SUBFACES

R. O. Seeman (added Geometrics, F.O. Dox 491, Eunnyssie, DA 9408d) F. Hiyanaki

An equivalant source signitie is Feweribed for come imming either one of two-diam melonal octant is field heaven arbitrary serfaces. In the swe-diamnsional case, the dipole surface is approached on a sel of plane tests with nonzine means of access of she dipole one-diamnsional case, the piese faces of she dipole surface is approached on a selective reduce to straight-liam segments. Application of the signification of the significant of the signification of the significant of the signification of the significant of the signi

one control of the state of the

IIIP Crustst Novemente
ODUSTIC ATUDITS IN BAJA CALIFOSSIA, MEXICO, AND THE
THALLANDOUS PROST-AMONE DATA FROM 1374 TO 1952
D. Darby, J. Gonesies and F. Losses (Olvisico of Perth
Eclasons, CICESS, F.C. Ser 8843, Ram Telbre, CA 31673)
The shert-range seeded to Fale from northern Rejs
California, Mexico, for the period 1916 to 1982, are
carfully analysed. These date mentithet to an undesstanding of the complan pettern of faulting assamlated
vito the Pasific-Mouth American plate boundary in this
raules. Aureay precisionsors evelented and mignificant
systematic surrors are found to exter. A tenhique of
studying a scale-from displacement solution he developed
to valid an Laterpracting the dele. We accorded that
(it the motion on the Each Mignet-Vallesitos famic system
is presently in a sight-lateral sense and el a level
that versents trilestration serveys as lesel semually,
(it) present profetic dass permit no ecclament about
moment on the Agne Stance fiselt, and (111) in mess,
whose Stant dellumates the Corro Frieto Smalt in the
valid de Kantesil, 13ea in a none which has undergone
valid de Kantesil, 13ea in a none which has undergone
to rate of 41 pps/s, orlands 8(3319)%, between 1980
did iti.
J. Coophys, Real E Broat Valiana

J. Coophys. Rea., S, Papea 541898

INTORNER HARMONICS OF THE BRAVITY POTENTIAL FUELD
R. H. Rage (Seismolnglost Laboratory, California institute of
Technology, Paradena, CA 91120)
Geold Roomatics are primarily the result of the density
desirated defining.

and thomsites are primarily the result of the density storage driving manile occavelled and piete motion. The total goals anomaly resulting from a gives density contrast to corresting arch is effected by the mass anomalies associated with the figuring occupant of the upper surface and bitered. sied with the flow-induced notornation of the upper surface and internal compositional boundaries, as well as by the Osestiy contract. Hasti. There bounderly deformedicing and honce the lotal gravity field, depend on the radial distribution of effective viscosity. If the indernal destrity contracts can be stillented, on in the case for authorized clashe, unstall obstitution to the placed on the depth and on the actions of viscosity with depth of the convecting system. The degree 40 components of the observed long everylength good are highly carriated with those producted by a density model for selection paid to explain that the effective viscosity increases with iston requires that the effective viscosity incresses with depth by a factor of 50 or more. The amplitude of the correlation senses sition wanted be explained by the Concily contrasts associ-ized with just the scientifely astroparts of subducted stabs, heaver. The exceptible can be explained if the Concily pos-trasts attracted and the contrast of the bond manheaver. The amplifieds can be explained if the benefit pos-train argorized with subduction sixtend into the boar quan-its or it oil dishorphers is piled up at the base of the upper quantic beneath subduction nones to a thickness in except of 500 km aver borizental distances of thesesseds of km. Maniferdia unervacion in a markle that has a viscosity increasing with death provious a simple explanation of the long savelangth good normalies over, ashduction longs, (Judgellen, Seciel, markle convection).

these lides to the much harder, but more interesting, learnes problem in three disamilation. There is no larged properties in the problem of (Blood traquenty analysis). Vacor Sesour, Res., Paper 490162 Haror Besour. Res., Paper MN0182

1180 Nator quality
A BOMPARACTRIC 19800 1851 FOP SEASONAL BATA WITE
SEGIAL DEPENDENCE
Robert M. Hirsch (U.S. Geological Survey, £10 Batlonti
Centar, Reston, Virginia, 22092), and Jomes R. Slati
Statistical tesis for monohonic tread in seesons!
(e.g., monthly) hydrologic tire series ore commonly
tenfounded by some of the following problems: nonnormal data, missing value, seasonality, tensoring
idelection ileis!, and serial dependence. As
estansion of the Mann-Kendali test for tread (dealgead
for such Oatal is pracented harm. Because the leet is
entirally based on rante, it is robust teglaist nonnormality and censoring. Seasonality and missing values
presant no liberarical or computational obstocales to lia
capplication. Mante Carlo aspaciments chow that, in
temms of type i arroc, it is robust against serial
correlation except when the dita have strong ing-term
parsistence (e.g., ARMA II, il monthly proceedes with
a 0.0,5) or chour record (~ 1 years). When yhere is
no secial sorrelation, it is less powerful chan a
related timplec lest whith is not robust tealnot
serial correlation. (time serion snelysia, seasonal
variations, trend detection, sarial sorrelation],
Matar Geomer. Res., Paper AMOSEL lidd General
FORRET HANAGEMENT FPR INCREASED TIMEFS AND WETER VIELDS
N. O. Bouwse (Resources for the Future, 1111
Massachusects Avenne, W. Westingrom, D.C., 1003b),
J. V. Krucille, and P. R. Berman
Tanasch toward August

coupled as those with longer spikes, but the heat coupling it achieved by burlai of the gauphones.

Georgical, vol. 4d, Mo. 4

Offit Seated or wiscallaneous

COMMELATIONS OF RADOS AND CARBOR (EDVOPIC MORSUAPHESTS

ALTO PITCOLOM AND RATURAL EAR AT CENTAT, OKLAHONA

E. L. Fleitcher (Descral Sizelie sessorth and overlanes). Company Content, P.D. 5 on C. Schenettery, NY 170011

L.O. Turner

Laden to toll gas and the carbon isotopic composition of carbon composite of carbon composeds in soil have been measured at 38 sites ever the Cement, Oklahona oil and Res field. Strong per the Cement, Oklahona oil and Res field. Strong per will and Etorage lanks and soil have been sensity of oil and per the carbon isotopic composition gas will and Etorage lanks and sensity of oil and per the carbon of the c

J. Goophys. Ros., C, Paper PC0218

3.40 Limnol on CPFERENCE OF HTPOLINETIC ORIGEN CONSUMPTION ON ANAIENT ORYGEN CONCENTRATION:
FRCT OR ARTIFACTI
R.J. Coreatt (Atcols Ecorgy of Casada Limitad, Rassarch Company, Chal's Sirat Nactear teboralorias, Chat River, Onterio, Roj 100 and F.M. Rigisc
Ten iches sladind in this investigation and the data presented by previous authors are atl yonalsiant with the hypothesis that rates of oxygen deplation is the hypothesis that rates of oxygen deplation or is made in the range of concentrations from 12 mg/1 to 1.0 mg/L. By definition, sarrobte respiration west too when there is no more oxygen present. Therefore the hypothesical payen defict can be modelled yes a fero order changes the dependent of oxygen concentration. Predictions of massonel changes to hypothesical payen concentration can be made by estimating the chope of the timer represented of exygen concentration against the Julian day when the sample was collected (oxygen, hypothesion).

1169 Runoff and Streamfon
A PHYSICALTY BASED FLOOD PREQUENCY 015TR SUTION
M. A. Olse-Ornsedot, J. O. Teldes, and 9, 1, Ores
(Bepartment of Civil Engineering, Room 48-31t,
M.L.T., Cambridge, KA 0219)
M.L.T., Cambridge, KA 02191 (memorizate at CIVI Ingleseron, N. 1.7. Cestridge, KA 02199]

The geomorphotimatic LUR theory, the joint probabitity density function of storm duration and intensity the storm duration and letter for the search of the infittration process are used to derice a thood frequency distribution that asside assed in regions with no creamsion records. The resulting thood frequency distribution is an assignment of the content of the

Hydrograph | Water Resour, Sas., Paget 480471 3100 kanot and stream ios TWO-COMPONENT EXTERME VALUE CHRISTEUTION FOR FLOOD PRECURNOT AMALYSIS F. Boest distilate of idrawlics a Contrasted Idrawlichs.

. T. Novet fistilate of idrawites a Continuous legantions, Université di Empoli, limiy). S. Figrantino and P. Varseos (Gipartmento di Olfens del Sució, Università della salabrie; and IRPI-CER, Unestas, [taly].

Theoretical considerations, Supported by Stalisticoi saniyale of 39 arenal flood ascine (AFS) of Italian saniyale of 39 arenal that the ten-component satrona. samiyale of 39 annual flood markine (AFS) of italian, basins, suggest that the two-component estrems withs (TCSY) Distribution onn be insumed in a parent Clood distribution; 1.0. one closely representably of the rest flood apparlence. This distribution of the rest flood apparlence. This distribution of the prival periods of introduced the interest of the prival contains of a mascand Poisson process and assumes locividual cloods to srice from a malabare of the exponential components. Its four parameters due

be raticaled by the pasions illelihood method. A regionalized ICEE distribution, with parameters representative of a eqt of 38 Italian AFS's, was Moun in closely reproduce the concerved distribution I seewheet and that of the largest order clatistic.

uith data for Telion sheets and polyshylene dussion undetensed by other treestigatess. Results show that depotition velocities for the Telion please are in the range 0.11 - 0.42 cm/set, while corsesponding velues for the party dishes eas in the sange 0.65 - 0.61 cm/set. Comparitous among the four types of surrogate surfaces the deposition velocities which incroses in the ordes lation sheets of ratio plates of party dishes dustfull buckets. Offertaces in collector geometry as white ecosposition are responsible for thems trands. Attropressize diotribution determined during the study show that buch of the 50.2 mass is associated with partialos of 0.5 - 1 pm satedymanic discress. Ecosyon; using the site distributions as inputs to dry deposition andels in the liseracus suggests tot lesser positions are responsible for most of the 30.2 mass deposition onto she unrogate surfaces. The calculoted scales for natural grass turisces are in sessemble signessed with meseuved deposition velocities onto the party diches. Overall, the results of this endy suggest that institut impaction and addiscutation of supermitron elaborate porticies are note important that deposition of subsisten articles are important that deposition of subsisten articles are note important that deposition of subsisten articles. J. Goophyn. Bes., Q. Paper 400396

J. Goophyn. Bes., O, Paper 4D0A96

3715 Chamteat Looposition ead chaoisal interactions
A KNREGICAL MODEL FOR SULFUR CHEBISTRY IN
ARRESTORTAL RAIMBANDS
O. C. Begg [Atmosphecit Saleacea Opportment
AK-40, Reliverally of Mathington, Seattle,
Mashington, 98195], S. A. Reliedga and P. T.
Hobbi

Massington, SSIYS, S. A. Retiedge and P. T. Hobbt
A two-dimenational, kinerwite ondel of varmfrontal peetSpitation has been engloyed to modal
the sulfur choolstry of worm-frontal rainbends.
Analysis of the model results indicate their
nucleotion seawenging, in-anoletion oxidation of
SO<sub>2</sub>, and imposites of pecticulate switts by
hydromatonra all coevelbute significating for wet
sulfate deposition, with nucleation scavenging
generality the most importent process. The modal
results to indicate that, is general, sulfate
deposition with me one-linear function of the
initial amount of salfur speales. Model prodictions of sulfate concentrations in cain from
warm-frontal calibrands and the raisallity of
these concentrations within individual cain
events are in accord with observations.

J. Ocophys. Ret., D. Yapar 400511

Manaschausects Avence, Md. Washington, D.C., 1903bi, J. V. Krutilie, end P. S. jberman
Essearch toward understanding the relation beingen vegetation and veter available for expression bas reached a trage where it is now useful to evaluate economic sepects of the Colorado Rochius are pathage the most likely candidates for an economically testible program. The sworage ennual precipitation is close to 30 inches, significantly more chem elsewhere in the Houthwest. Promosic development of the Front Range has provided a vary brish sation for water in residential and industrial uses. On the West Slope extensive water storage and utilization facilities are in place to economicate establisher and place to economicate establisher than the front Range, provides a promising maches.

Hamipulation of show deposicion end molt during a more fevorable ported by avail patch cuts has been demonstrated to increase unter swallshie for stransitou. The optimal laton for cutting with tupplementary thinning may been worked out and it develops that the value of the increase out and it develops that the value of the increase out and it develops that the value of the increase out and it develops that the value of the increase religial will acceed the cost for man wetertheds not rou distant

secred the cost for many unterthinds not no distant from present road access. An inscreating outcome, housear, is then the progres with the maximum present value does not accommodate timber production since the interval between rule is not long enough; to obtain merchantable (timber. This obtains turns on the volue of water roletive to the walue of timber.

Water Resour, Res.; [spins 44022b

JIP9 Ceneral [Grean Stormystet Management]

EFFECIS OF UPRANIZATION OF EFFAURISIES DE OVERFLOUS
AND FOLLUTART LABINGE FROM STONESFUR OVERFLOUS
AND FOLLUTART LABINGE FROM STONESFUR OVERFLOUP - A

OFFLYFO DISTRIBUTION APPROAFE

J. E. IGSPORTHEN DOSPITEMEN OF CIVIL Engineering,
Lirginia Eolytechnir institute and State University,
Blackaburg, VA 14001), J. W. Delisur

Based on exponential probability dansity functions
for the following independent hidrologic variables;
Yolume of runoff, intergrent them, and function of
runoff svent and heta dansity for the rescalef pollutant (PMP) concretation, and sexua density for tiver
flow volume Puring a critical forlid, new distriburions are derived for overflow volumes enforcedlying
etreup poliutant rententration. This is accomplished
be means of hidrological relationships between different vertables. Jimple transformations for the
effects of urhapisation on hydrologic variables are
suggested. The senfettical nodes is remperal with the
stmination node. "Tiomb".

Macter Secont. Res., Poper 490308

LIPS ALT Quelity
DRY DEPOSITION OF SULFATS DRTO SURJOCATE SURFACES
C. 1. Detidion Opportmens of Civil Engineering and
Engianceing 4 Public Yolicy, Cernegie-Mailon Universit
Pitieburgh, Fennsylvenia 15213), E.S. Lindberg, J.A.

Piciaburgh, Pennayivania 15713), E.S. tindberg, J.A. (choldi, L.C. Cartvrighi, and L.B. Landle Hawardsonie of Sd<sub>4</sub>2- flusos to eurtroguis mericam have been conducted se part of the Gry deposition intercompation(Stady in Champsign, illinois. Date for ferion plains without rims and fac polycerbouste pair! Plabes with I challes have been obtained and compared

Vater Resour. Res. : Copus 4V022b

Meteorology

3711 Chestoat Composition and Thislical Interactions VEGICAL DISTRIBUTION OF ACCOUNT STRONG AVIG AND SULPITE IN THE STRONGHOLD CHARGE STRONG AVIG AND SILPITE IN THE STRONGHOLD Charistry Civision, Brothhaven Martonal Laborstocy, Upton, NY [1911], S.

B. L. Tamor (Environmental Chamistry Givision, Brothsven Sattonal Laboratory, Upton, NY [1911], S. Kusst tnd 2. Johnson

Vertical profiles are reported for suiface, strong acid-to-suifare solar ratio and for related species. Once were obtained to the Mortheast USA by sixborns files-pack sampling at suitiple slittones with some concurrent groun? measurements, and by impactor measurements on the ground and slot using semi-quaptive sative FTIR spectorecapic stalyess. FISses-pach and impactor sproaches were compared during one sagertassed particular series of the sation in ambient series is suiting the seminant of the seminant series with 2. The sum of nature and untric acid degramss with 2 but the fraction as mirely acid. According to the the series of the self-sproaulists ratios in acrossis and seminant series. The results acrossis and seminant series and the recombine series of the series of the

3740 General Circulation

SAPOLIBIC CENTAGION OF PLANETARY TRANSTEST AND
STATIONARY MAYES FROM EURCPD STRITUMARY MARIS

J. P. Marito (Geophysical Ylutd Ownerics
Laboratory, Princeton University, Princeton,

M.J., 08340) and C. A. Ltn

The finear Introblity of forced trainous waves in
a barolimic senatifion is communed using a two level
quast-geoentcophic boar plane robet. Peaksist tonal
topography and diobalic forcings produce a tready
tate solution of planetary sonic atetionery wave.

Gameliote insiability of the forced waves gives rise
in transfernt yeriusbation modes of planetary tensi
scale and with a preferring medicilional scale of alout
tuice the radius of deformation. One of the desirest
pleastary modes to estationary and cessenbles ibs
observed electoracy wave partern. In the trady state
model, that fore can be oblinged only for certain
values of the martdioner scales of the forcings. It is
assessed that this estationary kode could contribute

Journal of Geophysical Research Volume 89 Number A5 May 1, 1984

Coronel Mass Elections Observed During the Soler Moximum Mission: Latiteds Clistribution and Rate of Occurrence (Paper 1A 1941) A. J. Hundhomen, C. B. Sowyer, L. House, R. M. E. Rilleg, and M. J. Wagnee Solar Modelation of Comic Ray Electrons 1978-1983 (Paper 4A0277) Point Eventson and Peter Meyee 20-47 Solar Weld Installion Temperatures Infarred From the Charge State Composition of Diffuse Particle
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Observation of an Oscillating Magnetic Field Shell at Threa Location: (Paper 3A1942)

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W. Baumighonn, M. Jauninger, G. Harrendel, and O. H. Bause M. Bauringer, G. Harrendel, and O. H. Bause Paper 4A00041

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Bruce E. Goldstein and Bruce T. Tsurutoni

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Direct Multiple Path Magnetospheric Chorus Emissions Obsyrved as Board

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D. Le Quèan, R. Pellar, and A. Roux

Effects of Oblique Double Layers on Upgoing Jon Pitch Angle and Gyrophese (Paper 4A0145)

M. E. Greenspan

Electromagnetic lon Cyclotros Mode IELF) Waves Generated by Auroral Electron Practipliation (Paper 3A1628)

M. Temperature and R. L. Lyanh.

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Quiesconce Paper 4A00591
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Convection Paper 4A0441
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D. D. Burbosa
Electron Precipitation Zones Around Major Ground-Dated VLF Signal Sources Paper 4A0121)
U. S. Juan, H. C. Chang, and R. A. Helliadd
2891
Charles Meeting of the Boler E Region by HE Pulses Paper 4A0090

Long Wevelength Limit of the Cerrent Convective Insubility Paper 4A0109)

Long Wevelength Limit of the Cerrent Convective Insubility Paper 4A0109)

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Long Wevelength Limit of the Cerrent Convective Insubility Paper 4A0109)

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Theories 1Paper 4A02061

P. A. Bernhardt

P. A. Bernha

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Shoet (Paper 4A0208)
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Eighty-Eight Year Periodicity in Solar-Terrestrial Phonomona Confirmed | IPaper 4A0311) J. Feynman and P. F. Fougere 3023 Author Indea

to the time average stationary wave distribution.

Applications to blocking are also considered.

Interiorence of stationary and quani-stationary modes
can apparently produce regional as well as global
blocking patterns. Itemsions, stationary planetary

J. Guophys., Pes., 0, Paper 400-67

273d M.O. in the Atmosphete (fog)
GHEMICAL COMPOSITION OF RADIATION FOG WATE AT ALBANY,
NEW YORS, AND 173 PPLATION-SHIP TO FOG BICROPHYSICE
B. Fuszi, 2.4. Castillo Histo University of Non York
at Albany, Atmosphorit Itisence Memostar Center, ESIII,
14dd Weenington Avenue, Albany, New York 11122f, J.F.
18usto and G.G. Laia
Bedial fon iog water samples collected at the Albany
18TY) Crunty Altpost show quite low and contest
compared with pravioutly published date on fog atidity:
the pH rangus from 4.1 to 8.4. This fog water louit
concentration is indicative of fow poliution in this
ates. The leading rachemism responsible for the
veriability in equacus reasontraction of son-valatifs
ionic concluments of thuse fogs is the prowth and
evaporation of deposition of the top forth and
evaporation at droplete, at reflected by the variation
of LVC during the fog evolution. Yor libs reason
the stign and composition of amenaoi on which log
droplet condensation lairs place is of sagor importance.
Oroplet alse spectro ensists show that thors is a need
tor improving the collection methods of fog vater, in
order to botter describe the chemistry isoslaved,
especially to cardialse the drop capture efficiency of
the tell sectors and tedute the sampling time for
that et traplution. Acid fog, fog altrophysics,
fog chemical responsition. D. Paper the 512 fog chroitef rempesitions. J. Geophys. Ros., D. Paper 150512

1750 Procipitation (Chemistry) SPATIAL VARIATION IN BUSY PROCISITATION CONSISTRY AND inguirations for Eagletin it an uptano can entert M. Buynolds (Institute of Persuettial Codony, Sangot Magnatch Station, Penthys Poad, Unagot, Doyneld, North

Mains, u.k.)

Bulk precipitation was collected weekly for asomical analysis over a parist of sixty from secha at all sites within the invaluance extention to fine Typer by in Mid-Maiss, U.F. Security indicate that for those cultivates, which are record and uninabilish, the impact and elevation of the culticates have no subject who elevat the elevation of the culticates have no subject who elevation. Siffetunces in rainfall catch within the utrough confliction in the cultivation to the uning the utroughest confliction to variation in solute to the cultivation to the unity of the second of the cultivation of the utroughest confliction can be second of the cultivation of the utroughest confliction can be second of the cultivation of the utroughest confliction can be second of the cultivation of the utroughest confliction of the cultivation of the utroughest confliction of the cultivation Witer Benour. Ses., Paper WORKS

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3235 Esocitical Phonomena
THERE UNUSUAL STROKES IN A TRIGGERER
LIGHINING PLASH
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V.P. Ideas and S.E. Drville Happrimmi
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1747 Convert (Metagralogy)
MIGH Effortion (METAGRAN) ANALYSIS OF GOIG-10'AL 71ME

University, York Collist, Coteander 20321, and Chiem-Clum Meas.

A Sathrique of high resolution fraquency analysis is deceloral which meats the decande of tagedring the characteristic fraquencies at an alocal pariodic process. Furtherwork, it has the projectly of stellitical consist-ency so that as the service size instance i ha art belief conversa to the true frequencies. This technique is applied to three jacological time series of it is shown that that characteristic frequencies are identical with some of the frequencies of the central orbital effects, or of refer linear trobinations. The malvals supports the Miantewitch orbital theory of long larn titeatic thanges, (Stuguency resolution, orbital elemants, geningical line series).

#### Mineralogy, Petrology, and Crystal Chemistry

A210 Crystal Cheststry
BIRBERLITC CHORKES FROM SEPERA LEGAL, WEST AFRICAT
LINES AL CHEMISTRIEE AND STUDENAL FOUTFPES.
Linda A. Yrapkins (Godlogy Osparezant, Ostvarelty of
Hassachasetts, Amberst, Mass. OtdoS), 1.0. Eolley and
Siegher E. Raigerty.
Chiortess occur as ovoid discrete modules (1-4m), so Nassachasetts, Amberet, Mees, Otdo5, 1.6. Delivy and Sigher E. Rajecty.
Chiortess occur as crotd discrete nodules (1-4m), as anhedral mateorysts (0.30m) and substral crystals (0.00m) in hisbartite, ark as cleavage replacement projects of high Fe (tevetuely placehrole), low T1+ Cryslegojites. The modules are severally deformed and four testural groups are recognized (librous, platy, tecrosized, moitple cleavage) that coulds of interpretare chicrites and verticalities of walable compositions. Major chombrak types in the modules are classified as high Ya (75mt), (etempolists Fe (15mt), and i.v. is fibrall vortaties with a salythop constating of low fe mailingh K (d.-2.3 mtl Eq.). The chiorites have high SiogleSchotter of the control o rion of grimary migratic chiarite in the hinherlife.

An. Nin., 69, 3-4

42IR crystel chemistry
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Mid-Siticalls by An Easse High series Middle
Middle of General Edutelion, University of Tolyo,
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anarys see bann applied to almutating the crystal
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Rorn-Miyar Syde regulsive forcat. Is tepusive
parewelers, lonia radias d, and lock tempretsibility

R for ag 2, 51 4, end 02 lons obtained from attractural dots of u-Mg\_5104 (Forstatita), have been appilet to gimuloting the crystal tiretures of d-Mg/1104, 1-Mg/25008, hypothetical \*g/1104 with  $\mathrm{Sr_2fb0_4}$  and  $\mathrm{CeFe_20_4}$  etructures, and  $\mathrm{MgSi0_3}$  with

psrottile and limenis structures. He result are tompred with the observed structures, the result are tompred with the observed structures religion by the 1-ray diffraction dose. We also predict the reputal alructures of the minurals in site of high pressure under the constraint that the cell diseations are ficed at the observed wines to high pressure. Our approach appears to be zecaseful in continuing the framework of selationly complast registed structures of high pressure changes with increasing pressure. [crystal structure, high pressure, silicate, potential analys).

d210 Crystal Chemistry
TITANIUM AND THE COLOR OF STAUROLITE
C.M. Wand (Saclogy Separtment, University of Stago,
Dunodin, see Zeafand
The visually essessed color intermstry of staurolies
appears to be directly proportional to the ritanium
contone. It is interred that the color is caused by
absorption due to Fe<sup>24</sup> - Ti<sup>45</sup> charge transfes. From
this and the ploochtmic scheme is in forther interred
that the titanium in simuncilite is intered in the
tetrahodrally coordinated to site. The sayled
difference in TI contact of the various sectors in
actor-zoond securolite can be vetlonalized note
astisfactority with TI in this site than to the
alternative octahodral of site. (Stadobits, ritanion
totrahedral coordination, sector-zoning).
Am. Hie., 59, 1-4

4210 Crystal chemistry
THE CRISTAL STRUCTURE OF SEGH CLIMPFERBOSITITE
S. Sueng (Department of Geometence, University of
Tuntubs, Ibarati, 201 Jopani, S. Himata, and C. T.

Tsukuba, Ibarsti, 201 Jopani, B. Himata, and C. T. Presitt
The crystal atructure of higs clinaferromilita [SeoIO\_1] with C2/g symmetry after the imparition from orthefectoelite at 1025°C was determined at 1980°C using a high-temporature four-circle Officactometer. The omli contents are g=9.928 filiā, b=5.79911ā, g=a.228114, =100.20°(11, y=48.211ā), The Pe2 polyhedron can be considered as also coordinated because the next tee oxygens are too delatent (2.181ā) for offoctive coordination with the Fu2 lon. The mean also bond length to 1.824ā and the mean P=0 bond lengths in the allfel and allel polyhedra are 2.178ā and t. 2005, taspectively. The polyhedral volume calculation rewells teet the six-to-ordinated gi polyhedron [11.3021. This is related to the large distortion of the Fu2-polyhedron in the bigh of leoderfositite strations. A mind for rendency mas observed for the high-citnopyconen atructures reported praviously. [Yrangition, Sigs temperature].

Am. Min., 69. 3-4

0229 Descriptive Micovelogy
dAMAdastys: A RR-SEANHAYJICE BKD COMPRESSON WITH
RESCREDISCATTS-LISE MESERALS
U.S. Barles (Department of Minavel Belancas, Assrican
Meseum of Maiural Elektory, New York, NY 100201, P.J.
Denn and O.L. Roosman
damagerite from Postansburg district, Capa Prosbece,
Republic of South Infraced speatra, and 3-ray
diffraction techniques. The data Indicate that Essagastic is lacatructural with breokebusosis; apace group
to P2/m issuamed center of symmetry with unit cell
constants a 49.1511, bc. 11(1), a27.661134, o = 12.71212,
finitered speatra Indicate Isst atrongly hydrogam-bonded
GMT is raw constant hydrogan-bonsing apoles in both
gamagerite and bracepturolic. Consequently, with a
recombination of proviously published atructure data, our
interpretation prefers the breocabanosita-type atricture
es a partially sold vesedate insensis and Phosphaio
containing Nings-1-type units rather then as a Sydraind
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variadate, is Spectra, unit cell date).
Am. Min., 19, 7-B
4.71d (Description Minoralogy)

Am. Min., 18, 7-B

4.74 (Description Mineralogy)
THE MINERALMA ACM PREDICTOR OF CONVOKITIONALLY EQUED
ADM-TIO (1975, AM) FELANIO SILICIC VOICAIR: MOCKS.
FROM THE MORPHITT CELDBER COUVEER REVAND-OPERAD
W. K. Control (Outt. Barth Eclences, Mensah Univ.,
Cloyton, Virieria, Australia 216dt.
The Mchanell children complex heredadegrepon, is a
composite follogue at fructure formed following scuption
of three sub-time suffer from a single concentionally
annual cogne thumber. The major and conformity and
portions of the tuffs are middly peraltation high-willow
ordered to the course of the molecular decision of the
sources are metalaminous low-silicar myolite. Associated
with the caldere complex are providered decise to
rhysitic laws flows and pesicaldece thyolite domos and
intrusives. Systematic verisions in mineral
recognitions and whole-rech rheolatry throughout the
entire willing voicant easier record the purposences
of highly trifric comediae through fractional
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entira siliria volcanic asito record the prepageness of highly tiliric tosendis through tracitoral rysistivation of dacifir or rhysdacitic paramatic expandituation of dacifir or rhysdacitic paramaticaxis. Frarionation from dacifra-rhysdacire in calsumous rhysitos (acutoride by recoval of phacicis; low-and high-dapresses and aluminism (ST Aroson for spatice, magnetic and liquide. Tracitoralism face hypodelic low-silica rhysitos to high-atiles commodito is contented by recoval of tarony-aided foldepar, questra; letroughte-fectubudrabstglie, feyallis and leaser limodio, magnotile and applica. Mfff annirhaest ince derite to rhysitos is promouned in ash-flow tuffs and postcalders university in the function of 7 an ac buff complaxing agent during trystal fractional on in the calders magnotibe to during trystal fractional on in the calders magnotibe function. Full surface of 7 an ac buff complaxing agent during trystal fractional on in the calders magnotibe side of the decision of 1 and 1

A260 Parageoesia, pelrography, and petrogenesia COEXTATING PARAGONITE AND QUASTZ IN SILLIMANIFIC ROCKS

ACOUTAINESS PARRONITE AND QUANTZ IN SILLIMARIFIC ROCES
FROM NEW MIXICO
JASTRY A. Orambing (Coperment of Coolegy, University
of New Mixico, Albaquatque, MR R7/21]
Paragesta has been identified by slatten microprob
and X-ray differed lon easiyats in four aperiment of
matemorphic rock free maribate New Mexico. The souts
aira cowsiste with quaras be three of these royle. One
cross from an area where hyanite, andaquelta and
allimanite comment. The other two come from widely
separated areas where elilimanite is the any polymorph
of ti,510, to be found, and allifements consists with
paragents sout quarta in each. The paragonite—quartz—
sit (mantte assemblages appear to be atakin, These are
ibs first reported actuatances of this assemblage sod
lits presence supports the Al-S10, triple point of
Noideney (1911).
Mascovite orduces to two of the assemblage sod

Moldaray (1911).

Mancovin orders in two of the paragonite-allimenta quantzine. Because these two samples crysimilized ar similar resperatures, and define a solven, B/(K+Se) tation should be attain for the two suscovites and for the two paragonites. Mosawar, large differences in Y/(C+Se) of semonics could be two paragonites. Mosawar, large differences in the two mamples code and for het miscilicem differences in the region of the comments of the region of the re analist hat significant differences in that ratio occur between the two paragonites. These variations may be telested to differences to caladosise costent of the mescovite in the ter rocks. Consisted with tentative engagesitous of previous owners, data passenced bers suggest bail, as 9s and Mg ace added to mescovice-ptragonite pairs. B/(S:Sa) leccases to omeovite and detreases in paragonite. This relationship has surjous implicis loos for mescovice-property enters and mescovice-paragonites have scall amounts of 9s and Mg. Paragonite, bymaite, and simulate of 9s and Mg. Paragonite, bymaite, and simulate silitamite). Am. Min., d9, 1-2

A260 Petrogenesia (Bangilan Thoisile) ORIGIN OF HAWALFAN INCLLIFE: A METASOMATIC MODEL

T. t. Wright (U. S. Geo) Agizal Survey, Restoe, 9(rginls 22092) Havai (so Thoisitta is generated by shear malting at the boundary between lithosphere and attheosphere in a marits which has already been certed to yisid sid-ocean ridge thoisits and been setted to yisid sid-ocean ridge thoisits and been setted to yisid sid-ocean ridge thoisits and been set sequently matatomatis and. The metagomatic cases are set in the control of the sequently and sequently alled and sequently alled and sequently alled and sequently alled on the foundation of the sequently are sed more upward in respons to a thermal plume. Helting and crupits of Navetien the string and crupits of Navetien storage and secretary and sequently as a perfect of shift in the sequently as a perfect of the sequently services and sequently sequently and sequently inricherat. J. Googhyo. Rem., S. Paper 331513

4260 Patrogenesis [Hewalian Thelaiita] ORIGIN OF HAMAIIAN THOUSTILE: & MEJASOMATIC MODEL T. L. Kright (U. S. Geologicoi Survey, Reaton, Yirginia 22092)

Virginia 22092)

Hawaifan Iholofite is gammatad by shear meiting at the boundary between II ihosphere and ambanosphers ie a meale which has airesdy Gommathanosphers ie a meale which has airesdy Gommathanosphers in a meale which has airesdy Gommathanosphers in the seasons it as measured in the subsequently metagons in the commative fluid and maybibule precipitate from that fluid.

Hetagons iic contituants originets in the low-velocity some and sown upward for response to otherwelplums. Balting and amptions of Hawailan Thoisiits are appeared by a pariod of thailow etorage not exceeding a fir decadas. Priegry Hawailan dagma have 20-225 MgG. Olivins is lotteduring expert transport and eggin during storoga such that the sewrege MgC content of stored magma is 73-145 and eruptad magma (e 9-10%. Setules themical verlation seen at lituues is establed to verying degrees of postial meiting and asteromatic earlchests.

earicheani. J. Caophys. Res., d. Paper 2d1513

tild Properilan of Minorala
THE MEAN OF FUSION OF NANATTE
J.F. Stebbles (Earth Sciences Civision, Lawrence SerJ.F. Stebbles (Earth Sciences Civision, Lawrence SerKeley behovelery, derbeley CA 91-93-00, j. 5.5 Carnichael
The relation enthelpies (H. 93-200, ol crystalline
fayallic [fs. 540.) and of the liquid seculing from the
telling of Myalita in platinum and iran-plated capsuite
have been cassured from 865 to 1705K by drop calculationty. Analyses of the amples quesched from the liquid
show that bacesses of incongruent maiting and disprepartionacion of FeD during realtug, a mixture of pheses was
produced, penalbly including the obseral minimite
(\*\*Fo.(Sin.).). Keasawiced on the obseral minimite
(\*\*Fo.(Sin.).). Keasawiced on the obseral minimite
httus, incongruent maiting at 1490X of 83.111. kJ/soi
and an mechalpy of hypothetical congruent maiting of
R9.211.1 kJ/soi. These capacity, anthalpy, maiting).
Am. Hin., 56, 1-4

Am. Min., 69, 1-4

Am. Min., 69, 1-4

Alid Properties of Siderale

SITING PROPERTIES OF AUDICHOSTICATE dansets, And Applications to destruct Baseline and Sizile and Springer and Sizile and Second, 8.8. Department by Georgia and Sizile and Second, 8.8. Department of Geology, Encology College druckly and Farman and Sizile and Second, 8.8. Department of Geology, Encology College druckly and Farman and Sizile and Second Sizile and Independent of the Compacitions of the second size and Worl's 1952 well-to-component subregular focunization. The general-best is Kny-geothermometer of Perry and Spear (1972) has been contested for the compositional effect on the bests of those results. The setimated pressures of a large subset of natural Gr-Plag-Aljaiogias of fiction on the bests of those results. The setimated pressures of a large subset of natural Gr-Plag-Aljaiogias factor of GPA() assemblages (apaning a temparature range of 1500-900°C) according to a cross obtained be this work and a An decived by Segma and Ribbe (1972) are in patrict agreement with his AM phase Glagram of Moldaway, Furthermore, simultaneous esicularions of P and y for the GPA()-but its assemblages described by Rodges and Spear (1961, Am. Minavel.) iron New Macapahire yield conditions very close to the 1d triple point, in conforting with their conclusion based on the spatial distribution of AS polymorphe. A summary of the binary Mategules and ternary beteration persecutors [C] ace as follows (Cal/pola of ration). Ca-Pa joint Mg(Cal-a)d (14d9), Mg(Cal-a)2d (1600), Mg-Cal-a, Ja-Mg-Cal-a, Ja-Mg-Cal-

(1449), Walfa)-AB2d (1660), Walf.5 a.u. 1 Se-Mg: Wg(Pa) = 240, V<sub>g</sub>(Hg)=2100 (1500)| V<sub>g</sub>=0; <u>Hg-Ha</u>; W<sub>G</sub> = W<sub>g</sub>=3000 11509|| <u>Ca-Ha</u>; lincolton and Be-too (1980, JGR1; Other binotion: Cangely and Kennedy (1974, CMF1; C<sub>133</sub>=-3300, C<sub>124</sub>-1523, C<sub>134</sub>-7625, C<sub>234</sub>--1150 with 1-Ca, 2-Eq. 1-F0, 4-Mail C<sup>26</sup>(1-1) = Wi<sup>2</sup>B<sub>1</sub> + W<sub>G</sub><sup>1</sup>C<sub>1</sub>)X<sub>1</sub>X<sub>3</sub>, Am. Alm., 69, 1-2

t290 Instruments (Neitastameter)
THE JUNISH'S PERFACTORITES AS A HIMSPALOGICAL TOOL
C. S. Muribox, Jr. (Department of Godiogical Sciences,
Barvard University, Cambridge, Massochusatte, 02738;
The joveles's tofactive indices of any sinoral baving
e single palished surface of at least 1 and to a
preceled of shout 0.002. You came crystallographic
crientations of the polished surface of antaotropic
crystals, it is assessant to determine the angles the
vibration discribing of the meanured cefractive indices
make with the pottened surface. This is accomplished by
viasing the refractments assis through a retardia
polarising filter on which the Iransalston direction is
indicated. Bit the involvedge of theme angles, it is
goosalble to hell if a crystal is unlexial or blessis; it
is unlaxied trystals to disrlayulah of from the and hell the
optic sign, and la blaxied crystals to lowestly all
thive retructive indices and thus determine the optic
sign. Bisliar ansauraments one be made on a single
aimeral grain in a polished thin mention.
(Metrantments, restrective index).
Am. His., 69, 1-4

also Binarelogy, Petrology and Crystal Chamimity
(INTORNAM RELING LAN: ANNARRONIC CORRECTION AND TEST
OF ITS YALPITY FOR BINERALS
G. H. Woll (Goology Department, University of California, Berheisy, Chilifornia, 94120). S. Jannios
High-pressure experimental data are used to evolucte
the well-dity of the Undermost meliting critarion for
minerals. Serause anharmonicity can be mignificant at
the High temperatures associated with melting, loading
order ambermonic contribations to the magnificant at
the High temperatures associated with melting, loading
order ambermonic contribations to the magnificant of
the personal formulation of the Lindemann critarion.
The personade required be this Lindemann cryteasion
table decertained from an inversion of intermodynomic
data so that a liver comparison with experimental
melting data can be made without resort to model
potentials, in general, we find that although stocic
vibrations can be significantly anharmonic mear the
maining point, the shape of the melcing curse predicted
from the Lindemann critarion is not used influenced by
anharmonicilly. We demonstrate that the Lindemann
expression is inconstatated with experimental aniting
dara for a variety of submration, particularly at low
preasures. In some cuses (argon, sodium chieride and
potential meliting down observed of
high pressures are consistent with a Lindemann
expression. In general, we find that a Lindemann
expression in more of naturels. Therefore, an
application of the Lindemann has be dusted the peliting
lemperatures of minerals at high pressures, and to
do nawing behavior of niturels. Therefore, an
application of the Lindemann has be dusted the feel pressures and to
do not make the pressure

J. Geophys. Res., B. Paper 44d431 Oceanography

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THE VORIATION OF SEA SERVACE TRIPELATINE IN 1974 AND
1971 PART (IT THE EMPOLATION WITH MIZE LATTH PROPELS
a. Hiyshods and A. Mosail, (Geophysical Fluid
dynamics laboratory/MOSA). Princaton Delveralty,
Princaton, New Jarsay 05548;

Lo consistion with a study of the extreme weather
awants ever the Morth Ambrican Continget in Jacobary,
1971, santyans wate performed to investiante characteristic properties of spatial and tamporal variation,
of mas surface temperature (BRT) for the years of 1974
and 1911, uning world distribution of SST described in
the eccessoring paper, Perl 1. The time evolution of
ocean resperature patients for these years are displayed by initivational slattifuction dingrams of SST,
und longitude-time (SoveMilar) dingrams. Office
triusic integrat model med Neuton-burblo's turbulence
closure sodel of the sleed layer news applied to relculate the SST amounty to the Morthern Seplaphora,
using realistic atmospheria forcing, locreams of time
variability of the axternat forcing laced to se syptaolably laptowed shules into of the SST emealy fields.
Both models seve reasseable external pradictions for
about 5 months in winfer time, if the realistic exterpal fortings were appellied. (EdT slacialion, mised
tayer models),
d. Geophys. Sam. C. Papar 4CQ438

AND Charlest queency through the service of a service of the assumption of attack and service and service of the assumption of attack and service and

downers live and estation of organic dericas educated alving of inorganic carbon deforming the vertendal relation of organic dericas educated alving of inorganic carbon deforming the vertendal relation of longuate carbon in the organic first mathematical statement of this behaves using an inpiritation of the statement of this behaves using an inpiritation of the statement of the vertical formula for the downward organic flux determined inorganic catbon profile containing one parameter of the statement of primary productivity mathematically affect coefficient. The best estimate for this tests obtained by culciating the variants between the avoidable later gasic carbon concentration data and the derived array as 15167 and C = 4. This ratio is consistent with a variance hetween the target of the stage of the trips of the stage of the trips of the stage of the trips of the stage of the section at 1. 1980; Stulver, 1989; Stulver, and Gosy, 191), and is equivalent to 2P to he goary and for production using the definition of Spring and Is equivalent to 2P to he goary of the 0. 1. Department of the participant of the content of the cont

[1919]. Work pariotand under the asspices of the G. I. Deput-ment of Energy by the Lawrence Livermore Halferst Libe-ratory under contract No. 0-1405-187-18. J. Goophys. Mas. C. Paper 40081

of 20 Distributions a Water Resons

QUANTIFICATION OF HOUSE ADDRESS

P. P. Wied and C. J. Cloder una distribut Technology
Distribution, Bayer Resourch Laboratory, Washington, b.C.,
2017 d

Laperineur course periodeced to examine 18s close I sperificate are perioded to contine inserting and transition of the unitary local Stream loga. A transit is put to one whose total Stream loga, and dillumes into the other as the tale wolve is time. It appears who of the transit stratiline is considered in the light of conservation of potential certificity. Alternatic viscosity and tracer diffusivity are end warled over two orders of magnitude, and tracer behavior changes greatly. The madegy of this work to the interaction of a same tore ting with the Suff Stream in made, with the stranger of this work to the interaction of a same tore ting with the Suff Stream in made, with the stranger observed in ring Stream increasings, to those observed in ring Stream increasings.

1. Reophys. Ben., C. Paper 4463th

ElbS Surface Gaves ESTIMATOR OF THE JOINT STATISTICS OF AMPLISHMS ASD PREIODS MY OCCAN WAYER URING AN INTEGRAL TRANSPORT

TECHNIQUE

E.F. Shus and W. B. Belwille (E.M. Sarsons Laborstory,
Beanachusatta fnatftute of Technology, Cambidge, 32
42139) Basaschusatts fractiute of Technology, Cassida, 24
2139)
As integral iranaform (the Hilbert Trausfurs) mitod
La used to obtain continuous time setles of wire
amplitude and perfod from ocean wave sheurramais. Pa
joint atastattes of these two worldsian are determined
and directly compared with the theoretical probability
densitites peedicted by Longust-Higgins (1975, 1885),
doed agreement is found for date from both make ask
buctitees see stales over a bread range of benchichtetile action desofds the ambiguithet in the deliafities
of wave amplitude and pariod found in sectior
comparisons of field data with theory. IVava
sistledical
J. Geophys. Bas., C. Paper 467295

A. Gaophya. Baa., C. Papar Ar 2395

4770 Turbulanta and diffution
roghation of THERMOCHINES IN ZEPO-MEAN-SMEAR
TURBULENCE
Rory O.R.Y. Thempton (CSIRO Division of Ocasnography.
G.P.O. Bo: 1516, Hobert, Issaenia, Australia, 7001).
Reating q at the surface of a turbulant and,
initially, unsiratified occum may form a thermotine,
if strong enough. It is proposed here first the
heating it efromg anough if turbulance occurs
tufficiently rersly past some depit not to transport
hast downward. Turbulenta is laten not to cross if
the gradiant Richordson number R = N<sup>2</sup>/<sub>2</sub>/<sub>2</sub> \ \( \frac{1}{2} \) \( \frac{1}{2} \) the problem of the transport
hast downward. Turbulenta is laten not to occus if
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that layer, increasing Ri and forming a thermocline,
that layer, increasing Ri and forming a thermocline,
that layer, increasing Ri and forming a thermocline,
that he papulation Richerdson number Criberico
translates to: if H \( \frac{1}{2} \) \( \frac{1}{2} J. Osophie. Hae., C. Paper 400545

#### Particles and Fields-Interplanetary Space

S146 Shock Mavas
SUPRAINERMAL 19NS UPSIREAM YROM INTERPLANT—
1ARY SHOCKS
J. T. Soaling (University of California, Lot
Alamos holional teberolory 87545), S. J.
Bame, N. C. Faidman, G. Machemon, R.
Schopke, and C. T. Ruscell
Suprathermal ions with anorgies believed
soler wind thermal energies and 29 keV ara
octacionally observed broad of outword propegating interplanelery thaths with the tes
itemes/Garching last plasme experiment on
1SEE-1 and -2. Compared to tuprathermal ion
valority distributions observed upstress from
the aerth's bow shoch, the upstress interplanetary thoch ion voldcity distributions
are relatively structureless, and the partitol fluxor are loss intense. Typically like
suprainsmal ion distribution coorges smoothly irea the soler wind thermal distributions
and is nearly learnerly interpole in the solar wind
freme. Such distributions are observed with
the fest plasma experiment only in attectation with interplanetary shelts. Flaidaligned beams, kidney beam-inspect
distributions, shells of ions to volocity
spece, and bunches af gyrating inter-ell
common to the upstrace region of the earth's
bow shock-hove not been observed when of
interplenetery shocks. Highly structured on
valority distributions observed upstress of
interplenetery shocks. Highly structured on
valority are indirectly by the nearly special
reflaction of solar elad ions at the shock, or
concessuance of the generally high Hach number
of the tolar wind flow at 1 AU. By way ar
contrest, most interplenetery shocks at 1 AU
have low, subcritical Hach numbers, and solar
wind ion reflection at these shocks does not
suprathermed ion distributions
to high energies at interplenetary theptis,
leaves of shocked thermal plasma ecrost
lines four Hach number shocks frow the domthream on the subsched thermal plasma ecrost
lines four Hach number shocks frow the dom-Leatoge of shoched thereal plants ecrost-hees tow Hach number shocks from the dom-tream regions may play an important role to producing upsfraum suprethormal ion popula-tions and may theralore centified the first step in the arceleration of solar wind ions step in the arceleration of solar wind ions ip high amergios at these whoelt, ion accoloration).

J. Paophys. Sme., A. Paper 4AD483 514d Particles and fleids - interviewers Space (abock waves)
PLASHA AND BRENGETIC PARTICLE STRUCTURE UPSTREEM OF A

(aboch waves)
PLANK AND SHERGETIC PARTICLE STRUCTURE UTSITEM of a
QUASI-PARALLEL INTERPLANETARY SHOCK
L. Y. Barnel of al. (TRM Space and Technology Occus,
L. Room Lide, One Space Sark, Radondo Back,
lide, R. Room Lide, One Space Sark, Radondo Back,
lide, R. Room Lide, One Space Sark, Radondo Back,
of the laterytanetary magnetic and almostic fields,
electrostacic plasma wavas, to day process and
ficience accelerator of energir protons. The first
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of 15 hay process increased by a force 15 in the life
of 15 hay process increased magnetic structure. In the life
for account of the process increase of the shock, "the increase of the life of

which the system undergoes a quest-stead; state E x à drill. in such a sistem, the polarization induced seil-clatite indid indide all the plasma flouds and the sementali; equal and uniform. The method of image dipolar previously developed for smill-squasterial sprond Y bubbles is used to television the less attancous electric field assetly. It is found that, even for small separation distances for which the inter-cloud interaction is significant, the electric field lesids the clouds weaking mastly uniform both invarially and from those to due for the small play plays a cloud performer to the state of the small play plays clonds drill is anison without thought the smiliple plays clonds drill is anison without changing that geometrical sheeps. This constitutions as quasi-stead; etals configuration. The inplications as discussed. iscumsed. . Geophys. Ros., A, Paper 4A0525

C. I. Kanzel et al. 1780 Space and Technology troop, 81dg, Ri. Poon 117h, One Space Park, Redomdo Brath, California, 90278]

An objective of this paper is to detureine the jusp in please parameters across the November 12, 1978 interplanetery Aback, sufficiently accurately to test in a subsequent paper a major prediction all shock acceleration theory-the dependent of the terrystic ion spectral tudes upon the density compression rate. We use 1811-1 and -1 measurements of the majoratic fuel and electron and proton densities, temperatures, and built selections, as well as 15th-1 alpha particle nateurscants, and confirm the 1821-1 aleatron dunations using plana wave measurements. He notes for the oback means using four independent methods, and show that the upstream and downstream flow patemeters are confistent so better then 112 with 1837 Eachnine-Hugenist jump conditions. We conclude that the November 12, 1918 sheed was a high speed 1012hm-11, apparential, quasi-parallel 10gm-11, spectrical, quasi-parallel 10gm-11, spectrical, quasi-parallel 10gm-11, spectrical, and these dissipative scalelengths, one of these dissipative scalelengths, one of a live terror radii sasceinted with its suspective in 10 pg associated with the suspective of the section of

Sign Scient Viol Pieses
A RE-HEAVINATION OF ROTAVIONAL AND TANGENVILL
PISCOTTIMUTIES IN THE SOLAN VING
M. Mengabener (Jat Propulation Laboratory, California
Restitute of Technology, Pasadans, CA 911001, C. E.
Cisy, A. S. Soldstein, E. T. Teurulaol, and S. O.
Tuckil

Particles and Fields—

MIGATING AROSAL PARMY DEPOSITION IN THE MIDDLE ADMINEST ILEBOTION OF Sinceley Atmospheres, MASS/Coldand Space Silpht Contor, Greenheit, MD 207111, C. R. Jachan, J. B. htross and F. Serine

From 1976 through 1082, of got 41 or love eligibil inc

From 1936 through 1982, edgit distinct eligibilities surptil steams have have probed with surbet paylonds in a series of Eigh is illude studies at Juder Visit laterath Lange, Alexts and Andrew at Juder Visit laterath Lange, Alexts and Andrew Southern the Intermedit Lange, Alexts and Andrew Southern the Intermedit Lange, Alexts and the substitute of the Intermedit paylong have contained a view and sentential statement paylong in promitting a computer of them and the statement of the middle stooghers. Although the specifics of each ovent those of the range of values for energy line and appeared to refer and experient laterates, certain general characteristics paraint in all cases. The primary energy line and hopeanist laterates, certain general characteristics and hopeanist laterates. The primary conceiling in found to dominate alongs that the statement of the statement of the statement when it is appeared in a separate alithude ragion, with the statement usually controlling lonisation in the appear has a statement usually controlling lonisation in the appear to should be a statement of the lower considered in and ling studies for the langestest usually controlling studies for the langestest underly of the lower monosphale (11-70 km), yet his excilation is expelled conductivity in account of a lacture of two. Norcover, the portistence of celasivitatic discinces as 10 important account in all owents a resided here alrungity togets that this deliciency be contained. (Autori, electron answersements, x-roy monourents, attempheric contestion).

J. desphys. Res., A, Papar AGAS)

Sit ionuspheric distorbances

NIGH-ATTITUDE (REEGULARTIES (S TOR LOWER P-SECTION)

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1. Bodrigues and S. P. Seusercanica (E.A. Nulbure

Center for Kraco Sessarchi Seval Messarch Leinerory,

Mashinghos, DC 2012)

A wide range of tower P-region irvegularity scale

alias fit m - 15d km) at high corcharn latitudes Serios

the spring and summer of 1874 has been ortwised. The

marphology and intensity distribution of the irregular
riles suggest that particles pracipitation to the pri
mit source of the interest fa.g., planta isneebilition!

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tions of coderate goodangestic artivity (S, -2-1, AR (
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and asall seals (7.5 km > L. > 75 el Irregularilies era

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ilet; foir cap protellecion is the course. The

silitude range (179 - 208 km) of the observations

let; foir cap protellecion is the prisery

the streeylarities to sufficiently feet that course the

streeylarities to sufficiently feet that covertion

that transport the unbarved icregularities for from

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J. Geobys. Ras., d. yspar lidde?

150 lon-latticed ionospheric currents

1530 Low-latiteds innospheric turrects
GLOMOSTIC PRESURBATIONS AT LOW LATITUDES DESERVED BY

J. Stophys. Res., A. Super 4A0521

Ionosphere

5515 (Auroras)

5590 Techalques (locospheric relisation)
THE ADDIO POWER REPLECTED FROM ROUGH AND UNDULATING
10x0578ERIC TERRACES
J. G. Whitehead (Physics Department, Untwormity of
quasanismad, ic, tucis, Q.td67, Australia), V. G. From
and L. G. Smith
It is shown for both rough and undulating guriaces
that the mean redio power telisated by the loncephera
avateged over a sufficiently long time is assectly the
same as for a macoch liar surince of the same height
provided the soundar is squally semilative for etheos
trom all directions. When making radio wave absorption
necessrements under spread conditions the total
integrated power over the whole time the direct school
are being tacelved must be used but the direct school
artival of the first scho.
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#### Particles and Fields-Magnetosphere

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ASSOCIATIONS OF GYDMAGSELIC ACTIVILY WITH
PLASMA SHEFT INHSHING AND FEPANSION: 4 STAHISLIGAL Stupy
F. W. Honas (Lot dignot Hellonol tobosolory,
Los dismot, hw 87545), 7. Pylis and H. I. Werl,

Institute of Technology, Pandens, CA 9 1001, 0. S. Clay, h. S. Goldstein, E. T. Teurulaci, and S. Q. Clay, h. S. Goldstein, E. T. Teurulaci, and S. Q. Curcill

1825-) magnetic liais and proton data are used to study the proparties of rotational and tengancial discontinuities in the solet wind. A Sommarup-Cabili miniam verlance smelysis of the magnetic livid data for acid to decayote the Sicetions of the moveal to sach discontinuities at a Theo ministry of the continuities at a Theomatonia (19), depocing on the reference of the moveal to sach discontinuities at a Theomatonia (19), depocing on the reference of the amount of the acid component and the change of flaid substantially more them TOs, in agreement with mediar atudas using this match of for the sach flats the tree groups. The flaid sagnitude passes rerough a local cloium while the flaid direction is changing for some TTs, hat not for Us. The limit as accord with stree groups. The flaid sagnitude passes rerough a local cloium while the flaid direction is changing for some TTs, hat not for Us. The limit as accord and shall lowerisate for protons and the halium abundance are approximately compared the halium abundance are approximately compared the halium abundance are approximately compared the same accord at the true tryes. The product of plants density rimes the asisology lacior teads to be congressed accord all three types of discontinuity are consistent with the propagation of the valuality and liaid changes across all three types of discontinuity are consistent with the propagation of the valuality changes. The product of the proton base teletive to be a pricely proton hazar result in little textaction hatvase the alphase and the actondary proton base teletive to be pricety proton hazar result in little textaction hatvase the alphase and the proton hazar proton base teletive to be pricedy proton hazar result in little textaction hatvase the alphase and the proton hazar result in little textaction hatvase the alphase and the accondary proton hazar prot f. W. Monas (Lot disnot Hailonol tobosolory, ton diomot, but 87565). Pylia and R. I. Mari, Jr. ditociations of gaomagnatic activity in the sourced zone with telepings and aspensions of the magnetotal plasmo threat are axomined testiticistly in this report. He lirth identified many plasms theat thinnings and aspensions to plasma and priticia dara from Vala existizias and from 690 5 without reference to ground maynatir data. Increasanth wars groups according to the location of the detering satellite in the magnetotali, for each tuch group satellite in the magnetotali, for each tuch group 15a lines of thinning or aspension were then used as fiducial times in a suparpostad apoch analysis of the geomagnetic Al-index values that were trooded in eighthour intervals contared on the event times in a suparpostad apoch analysis of the geomagnetic library and the second the season times the classical signature of substome. Furthermore, they support carlier findings that plasma sheet thinning and aspention at the Vale orbit (rel8 Rg) tend to be aspeciated with, respectively, the oneat of the auroral toma negative buy stating beginning of the oneat of the auroral toma negative buy stating fraction of plasma teste apparation that the time of the onest of the analysis objugges in agreement with partier findings, large fraction of plasma teste apparation to half-thicknetoes of the aspectance of a prolonged enterval of disturbance. The sludy also show that many plasma sheet expansions the early plasma sheet expansions to elast vity showing no betwith substidence of a prolonged enterval of disturbance. The sludy also show that many plasma sheet expansions tre related simply to generally enhance of the distinctive fectures. (Plasma theet, geomagnetic activity).

I. Guophym. Rus., A. Paper 440441

5730 Magnotic Toll RECORDED ENERGIZATION IN THE GEOMAGNETIC TAIL CURRENT STATE MARGICATION IN THE GEOMAGNETIC LAIL CURPENT SELECTED INTEGET. INTEGET INTEGET. INTEGET INTEGET. INTEGET INTEGET. I

J. deophys., A, Paper 4AU494

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1722 Magantic tall
MICPOSTRUCTURE OF MACKETIG RECOMMECTION
IN LARKY'S MACKETUTATA

J. 6. Blebar (Setcol Research Poundation, University of Delaware, Newart, Polaware 1971d), B. G. Stoom, B. W. Homse, Jr., P. E. Osher, S. J. Sens, and B. F. tapping, A recent stedy of usguestic veconsaction in Parth's magnerotall idealified 5 events in whith a pulsa by besied electrons appeared near the end of an interval of fast laitward gives flow. Forthar investigation of these events has evented the following information on their microsurvertures; [11 Measurements of the alectron velocity distribution of the series process, in that the gross avolution of the distribution is from a marrower to a broader Maxwellian.

(2) During the heating pulse, a hump to often apparant in the tall of the mirrtroe distribution function at an average of 9-5 kg. This bump could be the remand of a hease penduced by a 2-5 ky peralisi potential drop. These, a possible sechesiae for the heating of electrons is the beam-plassa instability.

(2) The anguacit field during these secont is highly valiable in all three components. Part of this veriability and present from anguacit instability, the minimum variaona acelysis suggests that some of the sorm rapid variacelysis suggests that some of the sorm rapid variacelysis suggests that some of the sorm rapid variacelysis are large (10-20 mT) at times. The eigengest coultward fields are usually obasyed oast the beginning of the heating pulsa, while the attengest 7 cosponence generally count during the pre-heating interval of islived places flow. Transient Larga-acale obenges in the cornex augentualit current system are indicated by these observatione. (Magaela veconnection, substitute, angentoidalt, places about).

J. Geophys. Rec., d., Fapat 18045d

NAMES TO PERTURNATIONS AT LOW LATTUDES ORDERVED BY WALKET I. Xunda (Date Analysis Genter for Geomagneties and Spreadsportees, Paculty O'S Ectence, Kysto Potvarelly, From Scholler, I. Xunda (Date, Paculty O'S Ectence, Kysto Potvarelly, From Scholler, I. Xunda (Date), and T. Arski Uscospherk Periurbations 148, AD, AZ, and AF; at tow Latitudes are atudind by using MASSAT data during the atlantice are found: (1) AD Entrally shown angester velvem target at dush then at Scholler, and it, is lo good correlation with the Pat bedus to hath date and data wides. The difference between Marginet (2) AD above a glattuct vertailon mear the dip squator only on the down lade, with a sent labif of the first late to northern homisphere and negotive to the southern homisphere to the magnetosphere are disconting the Astitude. These observator fattles are disconting the second of the southern homisphere and magnetosphere.

(Homisphere) (Homisphere of magnetosphere and despendent of the southern homisphere of the magnetosphere.

(Homisphere) (Homisphere) of the magnetosphere. al42 Kagnotoshash
AMPPIRO THE MAGETIOSIGATE FIRED RETURES THE MAGETOSTHERIC
PAUDE AND THE SON SHOCE: EMPLICATIONS FOR MAGGETOSTHERIC
FASTICLE LEAGUS
J. d. Lohnsom (bestfrute of Geophysits and Planetsty
Physios, Haiverstry of Catifornia, Los Angelsa, Callfornia, 50024), S. J. Welker, C. T. Bessall, J. S.
Sprairer; S. S. Elsberg and P. J. Williams
Observationsi at edice have sitribated some of the
campairic (5 50 MeV) particles chairved at versions sires
mast the how shock and in the segmentation is a segmentation of the control of the control source. A large-made picture of the spatial
distribution of these particles in the beganateshesh is
difficult to obtale from the dail because of constantly tiol Flarus Motton, Convection, or Circutation
QMAIL-STAIN STATE MULTI-PLANEA GLOSP COSPIGNATIONS
IS DE F-REGION IONOSPHERS
7. 101, P. Verymaneyson, and S.I. Dession
The Dephology of a fiefta array of plasms density
schenosphia fautt-plane clouds) to the focosphera
for studied in order to determine the condition under

changing interplanatory conditions. Sate an approxi-cate picture of the volumes occupied by particles that originate in the vicinity of the magnetopause is obtained by capping magnetopheath magnetic field lines which drope over the magnetopause rhrough the how shack. Subsets of these field lines they connect to potential sties of congetic merging on the supectopause are also traced in the svent that the perticle leshage occurs preferentially where sornal composents of the isled are present across that boundary. The results of this bodeling exercise suggest that sorgetic megnetomberic particles which are not accurately to act the magneto-sheath in the region of the quasi-parallel shock. J. deophys. Sec., A, Paper 4,00316 J. deophys. Sec., A, Paper 4A0516

57th Magnatospheric configuration COMPSSISON OF IMPOUSE MACHETOSPHEES AT cenus AND TITAN A. 1. Yarigin and I. 1. Gringens I. P. Beas Haish/Goddard Space Plight Center, Greechalt, Haryland 20711)

I. P. Beas INSL/Goddard Space Flight Center, Greechalt, Baryland 2071)
Considerable evidence selets from Oats obtained by strifficial asteilites of Yanus describing the dateound bow shoot were whos davalops due to the interaction of the super-Alfvania, supersonts solar wind. Homever, there is no suce direct avidence for any bow sheet wave at Yitan due to be interaction with the od-rotating Saturnian magesbesphere. This is Secause the fact mode HHO Sach number see less thus unity at the time of Voyagar I close fly-by. In aptic of this difference in places regimes, incre is no eriain siriling similarity to these two interactions. Both obsidered to place flow have approcised lescapheres and are globall; non-magnetic. Downstress from both obsidering an induced bipolar magnetic stall is formed with a ceelral field reversal region which is analogous to les East's nautral sheat-places sheel saglon. There appears be be evidence for magnetic eving in these though talls so that magnetic reconnection between the oppositely directed in 11 lobes cours. The single tail ordering at Titan above avidance of acquing will be repeated tail ordering thar is not a personal stall arity observed morphing thars I am at a personate feature.

J. deophys. Hess., A. Fapar 4AD495

J. deophys. Hes., A. Paper 4AD495

5/NOSTOTE period (less than idey) variations of cognatic field SIMULTANEOUS OBSERVATIONS OF A PRESATION EVENT FROM THE CHORND, MITH RALLOWS AND WITH A CEOSTATICHARY SATELLITE ON ARMST 12, 1978

1. B. Iversen (Danish Space Passare), L. P. Bicck, K. Brenstad, R. Orard, O. Haarpondel, H. Junginger, d. Korih, O. Kramsar, H. Hedsen, J. Niskenea, M. Biadler, P. Tenekanen, K. M. Toriar, S. Utlaiand

A guitation seems with a period of 6-8 min has been observed abunitaneously by the geostationery autofilla OEGS 2 and two balloons located in the area magnatically conjugate to the matellite. The balloons were equipped with electric field and 8 way lestrucenia. The pulmation even occurred in the magnetic local time sector O6—11 determined by ground based measurements. The satellite instruments observed the aignature of a magnatosonic wave having a reddally invarid directed Dynating vector. The alectric field associated with the wave was closely correlated with the alectric lield detected by the balloon instrument near the foot point of the magnetic field ise through GEGS 2. The ground based chaervetions about hef the wave phase pattern was north-mouth attricted and that it moved from mast to west. The halloon X ray promurements showed a chrongly pulsating particle processing the content of the content

agazaraft la anothea and eath spacetraft chearves a degraces in the fundamental frayassey as it seves from naveleg (15 MH) to afternoon [10 MH). This frayonory behavior is explained in twee of standing Alfvéo waves, for which the frequency is detarohmed by the least edgestic field and please density. Occurrance of hersonio for 5-4 moves only during daytion hours (Re00-200d LT) and their frequency characteristicatugges! a broadband emergy senter least so the day aids. Fossible seismiths; when mounts e and anisothet where valenty. V. of the second threath fourth aids. Fossible seismith; were number a and assertant phase valually V, of the second through fourth becoming at a detailment from an organic interval darion ableb idention; bermonia frequencies move observed at BSE I and ATS d. Under the assemption of believed gropagation of constant-phase Erodis at the sace valentity for all these betweenless, we obtain 7. ~ 11dR he/s. (Haguatio sglastlone, bersonlo meves, J. Genphys. Res., A, Pepes 480521

J. Genphya. Rad., A, Papeo AAG521

Sy70 Short pacind variations of magnetic field
LORRYTHOMAL RECORDS IN PY 5 PUBATYONS AND THE BUBSTORM CORRENT WENGS

B. Lesier (department of delvesumy, Bosica University,
Bosica, MA 25515, and all Department of Physics, Univertity of York, destington, Torks 701 500, d.S.),
Y.J. Region and S.Y. Binapt

The shatesteristics of middetitude P1 5 quiestions
are studied using a sub-marcors supl-mant shale of magmelonalars which apens over four hears local magnetic
than P1 squistions are used to defice a inspired on
the P1 squistions are used to defice a inspired on
media. The wave propertian, fragmany, polyrishlos
media. The wave propertian, fragmany, polyrishlos
med cast-mest phase variations, are assuland in this
modelizate system. This silves us to moment the vave
abstracticities at langitudy between the architects of
the top Vield-milgand appress of the schriove autemat
reggs with the ubscratterities both sast and sent of
those meridiage. In an althout as alciains the laftysame of practiping surrent systems on our aniheats of

the substorm current location we use only PI 2 ps(antions which inition a magnetically quiet interval and which stard simulaneously with a magnetic hay. We find that the longitudinal patters of the horizontal golsviration silipse arbust found earlier, sateads heyout the merializes of the field-slighed surrants. The sense of wave horizontal poissization is predominantly comeirectoshwise at all longitudes though the insidence of linear and storbusts goinsization increases with Etatamos from the field-slighed current neridians. Estimates of signal phase elfferences between statics pairs, if beisproid as a signal phase propagation, show that westverd propagation dominates went of and within the field-slighed surrest maridians, but that eastward propagation dominates east of the ourset system. This is the observation title season andel introduced to explain the largifoldial variations in the signal frequency among stellings und load some variation in about faif the events sjudied, but could little on systematic behavior.

d. Geophye. San., A, Feper 4AO470

d. Geophys. Bass., A. Poper 4ACA70

1199 General lighteering!

BLOPI of SULTUR AND OXYGEN FROM 10

Andrew F. Cheen flobus coptine University, Applied Physica taboratory, Laurel, daryland, 80707)

Charged particle sputtering is re-examined as a sechanism for escape of sulfur and oxygen from locorotaring ions and energatic loss are considered, using the best available determinations of loc fluces and sputtering yleids. It is unclear whether molecular 500 to the dominant acaptum neutral from 10. or decade of and 1, but the Yoyager detection of 50 in the cold towes implies the presence of molecular 500 the cold towes implies the presence of molecular 500 the cold towes implies the presence of molecular 500 the cold towes implies the presence of molecular 500 in the cold towes implies the presence of molecular 500 the cold towes implies the presence of molecular 500 interest. This etcoophers and sulfur and oxtgen escape rates, hal they are not yet valed out, fonization and dissociation in a sputter comma make important contributions. In thich adeoxyphers codels, the neutral scape raise can be such higher, but the oxygen escape rates and to be soo high relative to the sulfur scape rate unless differed acquaration in the almosphere is limited, perhaps by rapid mining. (Cputtering, oxygen and sulfur assessed.)

organization in the presentation of contention of the content of the contention of the contention of t

J. Geophys. Pet., B. Paper 581893

#### Seismology

lies through OEDS 2. The ground based chasy veitons about hef the wave phase petern was north-couth attleted and that it moved from gast to west. The halloon X ray measurements aboved a chrongly pulsating particle precipitation, in close correlation with the intensity of the empeticulectron flam and the VLP eleastromagnetic rediction measured on the natallite suggesting a mave-particle interaction process. The pulmetions mean is originate beyond the geospherocom orbit. The study demonstrates to beyond the geospherocom orbit. The study demonstrates the uneftliness of eleastrancess measurements with a ground area magnetically conjugate to the smightle.

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371d Shoat-parted (less than 1 day) variations of magnetically conjugate and slapatary system. The class of Caphysics and Sapatary system. The stan and the size of a large plate rupturing aurro-quies, i.e., an event that breast the call of some of the allp thas occurs selembles; appear to vary greatly for different against of the allp thas occurs selembles; appear to vary greatly for different against of the size occurs selembles; and size of the si tude east d suring the next 20 years. All the other segments have only a small change [8.e., less then 5 to 108] of repturing in an evant of segmined near 8 during that interval. The assures of the san Andreas fault from opposite San Jose to San June Suttlata, which ruptured less than 1.5 of fn 1906 and which probably also broke in f000, is calvilated to have a moderate to high probability of an enthquake of magnited S 3/4 to 7 1/5 during the next 20 years. J. Goophys. Ses., S. Paper 430400

angeliess in 1/4 to 7 /72 during the next to years.

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MORENT-MAINSTRUGE RELATIONS IN THEORY AND PRACTICE
Thomas C. limbs [U.S. Geologice] Burvey, 545 MiddleStaid Road, Meele Park, CA 940/20) and Darid M. Bobre
The observation that solivates this accept to the difference to e-velocate in someti-magnitude relationt of
the Sove log M. • CM. • debreen central and southern
Califovele. This difference is out at oil related to
geographical aves; rather, it receits from positive
cuvesiure in the fog M. • M. plans and the relatively
large member of M. • S verthquahes to the cantral CaliSocial data sat. Mith the prescription that the farfield shear tayes from whith M. La takes he finisdevelon, bend-lietcod, white Gaussian onless to seconsovetion, we can estimate M. as a function of M. stona,
by fixing the symm stress drop at 100 bars and 9mas at
13 Ms. These model calcutations 91t available CaliSocial dyna-on with ecribing accuracy. This weage to
accurace strength is outfree: earthquakes with M. § 1055
dyna-on are unlikely to occur to Cafffornts, and earthquakes alth M. 4 decanose be recorded to Califovela, at
feast under ordinary conditions of recording parshquakes
at ordinary hypocoates! depths. Nore foundamentally,
the reservable good 91 of model to date implies that
the apparatus of the description of the stress of the collision of solis a stable and parvales feature of all (M. &
241 Califovela earthquakes whose apportral cover frequency itse in the "visithe" bandwidth, fo finat.

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